A STUDY OF POWER GENERATION FROM WOOD FUEL

for

RESTIGOUCHE INDUSTRIAL COMMISSION INC.
CAMPBELLTON, N.B.

ADI Limited
Engineering, Architecture, Planning
Management Consulting, Surveying.

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June 8, 1990

2952-1

Restigouche Industrial Commission Inc.
P.O. Box 825
Campbelton, N.B.
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ATTENTION: Sadie Perron, Commissioner

Dear Sadie:

Further to our meeting of June 4, 1990; we enclose herewith;

- The Glossary of Terms as applies to the report.
- A list of mills supplying cedar residue and the number of employees employed at each.

Your very truly,

D.E. Gorman

DEG/par

Encls.

Glossary of Terms

Cogeneration	the simultaneous production of mechanical energy which can be converted to electricity and useful thermal energy.
Capacity Factor	the percentage of full operating capacity achieved over a period of time.
Pro forma	plant economic operating results for each year, including all important line items, projected for several years into the future.
annual allowable cut (AAC) -	the volume of wood which should be cut annually, under management, from a given area over a specified or indefinite period of years.
sawmill residues	sawdust, bark, shavings, slabs, log-ends, etc. "left over" from a lumber sawmilling operation. The actual content of the residues varies with the size and type of sawmill.
developed cost	the price which must be charged for the power generated from the wood-fired plant in order to meet all costs including an allowance for return on equity.
moisture content - (MC)	the percentage of water in wood and calculated on a wet or dry basis. The wet basis is used in this report.

$$\text{MC (wet basis)} = \frac{\text{weight of water in wood}}{\text{total weight of wood including water}} \times 100$$

bone dry	wood having zero percent moisture.
whole Tree	the tree as harvested with bole, branches and top.

The following lists the mills from which we would obtain cedar residue for the proposed Kedgwick Wood-Fired Power Station. Data is provided as to quantity of residue available and the number of persons employed at each.

1. North America Forest Products Ltd. - Saint Quentin.

   This firm would supply a total of 42,000 tonnes of which some 7,800 will be cedar. The cedar would be processed and mixed with the other softwood species. It is understood that should a market not be available for the cedar they will continue to dispose of it in their teepee burner.

2. Ringuette Industries - Saint Anne de Madawaska

   We did not have information on this firm at time of report preparation and therefore have not included them in the supply plans. They produce a total of 20,000 tonnes per year most of which is cedar. At the present time the residue is sent to a landfill since it is not economical for him to process (pass through a hog) and transport to Frasers. He wants very much to develop a market for the residue but the price must be such as to provide him with at least $1. per tonne above cost. He will continue to operate should a market not develop but he is not sure for how long. The plant employs 30 persons on a year around basis.

3. Le Clerc and Frères Ltee - Saint Leonard

   This mill has 3 shingle saws and employs 10 to 12 men. It is not presently in operation due to poor demand. When the demand is good they operate 12 months per year and generate an estimated 5,000 tonnes of residue per year. Since the mill is not presently in operation, we have not included it in the fuel supply group. He normally disposes of the residue at a nearby land fill.

4. Kedgwick Lumber - Kedgwick

   This mill uses up to 90% cedar and produce an estimated 4,200 tonnes per year. This quantity has been included in our fuel supply. The plant employs 10-15 persons.

5. Bois Carré Saint Quentin

   This mill produces some 2,000 tonnes of cedar residue all of which has been included in our fuel supply. The employment at the plant ranges from 9 to 12 persons.

6. Cedre Restigouche - Saint Quentin

This mill produces cedar and hardwood products. This year (1990) they are not using any cedar but will return to shingle production should the market improve. They have a market for all the residue including the cedar which they have successfully processed and mixed with the hardwood residue. We have included their total residue as a fuel source for the proposed Kedgwick Power Station.

7. Atlantic Cedar Shingle Ltd. - Saint Quentin

We have not had any direct communication with this firm but from discussions with others we have concluded that they produce some 10,200 tonnes of cedar residue. Since this firm has 2 names we were trying to obtain data on the other name - Bardeau Cedre Atlantic without any success.

The quantity available from Atlantic should obviously be used as a fuel source for the plant.

The plant employs 25-30 persons.

Based on the 7 firms as outlined above and assuming that all or some may not continue operations if their cedar residue cannot be gainfully utilized - the number of persons affected is in the order of 100 to 125.

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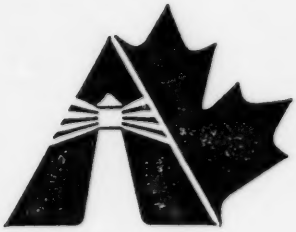

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EXECUTIVE SUMMARY

1. A plant capacity of 25 MW has been selected. The amount of wood residue (fuel) available within 100 km of the proposed site is well in excess of the plant requirements.

   The 25 MW capacity is favoured on the basis of:

   i) additional fuel as required for a larger plant would have to be recovered from roadside slash; this is a relatively high cost component.

   ii) the proposed system allows for wood fuel deliveries during an 8 hour day. It would be necessary to double the wood receiving, handling and day storage facilities to accommodate an incremental increase in the plant capacity. As an alternative, it would be possible to receive wood on a 2-shift basis. This would result in additional operating staff with an increase in cost of an estimated $100,000.00 per year.

   iii) the proposed turbine at 25 MW is at the top of a modular range and an increase in size would result in a disproportionate increase in cost.

   It is recommended that, given the favourable position in wood fuel availability, that a more detailed examination be given a larger capacity plant.

   As a guide to the committee, an order-of-magnitude data sheet has been developed and appears in Appendix IV. In examining this guide; consideration should be given the following:

   - While wood fuel, based on our recent investigations is available in quantities sufficient for a 50 MW plant, the cost will increase and the reliability of supply will diminish. These factors result in a higher risk for potential investors.

   - The plant would operate at higher steam conditions with improvement in overall plant efficiency, this would probably be offset by the higher cost for wood fuel.

   - As noted earlier, the wood fuel deliveries would require upwards of 80 loads per 8 hour day which may prove objectionable to the community.

2. A tentative location has been selected in the Kedgwick area for the wood-fired power plant.

   i) it is central to large quantities of wood residue from wood processing and from timber harvesting operations.

ii) there is a large sawmill, as well as other wood processing plants near the favoured site which could supply a portion of the fuel and may possibly wish to purchase some steam from the turbine cycle.

iii) the site is close to a high voltage power transmission line of NB Power.

3. There are three wood residue streams which can be used as fuel for a wood-fired plant in the Kedgwick area. These are:

i) residue from wood processing plants

ii) residue (hardwood) fro forest residue at roadside

iii) residue (softwood) from forest residue at roadside.

The sources are in order of cost with No. i being the lowest.

It is significant to note that the mills currently using cedar as their fibre resource do not always have a market for the residue from their operations. The cedar bark is difficult to process into fuel and the chips have a low "Btu to volume" ratio. Some operators indicate that failure to obtain an economic means for disposal could result in shutdown of their plant. Allowance is made in this study for use of the cedar residue, as reported by the operators.

Our findings indicate that:

i) for a 50% capacity factor on the 25 MW unit and a steam feed to an adjacent sawmill, there is an adequate supply of mill residue.

ii) for an 80% capacity factor and the same delivery of steam, it will be necessary to use all the mill residue as reported, as well as a portion only of the hardwood forest residue.

iii) for a 90% capacity factor and the same delivery of steam, it will be necessary to use all of the mill residue plus a portion only of the economically recoverable hardwood and softwood residue.

4. A conventional design of plant is proposed having condensing facilities for turbine exhaust but with a steam supply taken from an extraction point on the turbine to feed the total steam requirements for an adjacent sawmill.

5. The estimated cost of plant and equipment (25 MW), in 1990 dollars, is estimated to be $66,000,000. This amount includes an allowance for interest during construction.

   The estimated operating costs are also stated in 1990 dollars with an escalation allowance of 4% per year.

   The cost for power and steam are shown for the year 1994. Year 1 is assumed to be 1994.

6. The plant would have an operating staff of 30. The employment generated in wood fuel supply, including the transport of residue, is estimated at 45, giving a total of 75 persons employed directly in the supply of wood fuel and plant operations.

7. Three (3) proforma statements have been developed (reference Appendix III); one demonstrating a privately funded plant without any government assistance (the base case); the second with a grant in the amount of 50% of total capital costs; and the third which shows the price that would have to be paid for the power in order to arrive at a break even position. Reference should be made to the 90% capacity factor data.

   The base case shows the power plant to generate negative cash flows throughout its 20 year life, thus making it unattractive as an investment. The analysis of the 50% grant scenario shows the power plant to generate a positive cash flow throughout its 20 year life, and an after tax Return on Equity Investment of about 11.7%. The third statement shows that the price charged for power in the first year of operation would be 10.5¢ for kWh to achieve a break even position after an allowance of 20%.

8. Of the three (3) financing scenarios examined, only two; the one with the 50% grant and the one with the increase in power sales revenue, result in payment of corporate taxes.

   The tax payments during the first 20 years of operation for the 90% Capacity Factor are:

   1) the 50% grant option amounts to $3,830,000 when discounted at prime interest rate back to the year 1994, assumed to be the date of start-up. The prime rate is assumed to be 14%.

   2) the option which allows for increased revenue from power sales amounts to $7,785,000 when discounted at a prime rate back to the year 1994, assumed to be the date of start-up. The prime rate is assumed to be 14%.

9. The operation of the power plant will result in 75 full-time jobs, most of which will be associated with the supply and transportation of wood fuel. After accounting for the indirect employment impacts, as well as the displaced employment, the project will result in a net increase in provincial employment of 67 jobs. The net impact on provincial income is estimated at $3.2 million annually.

   Other significant positive impacts include the transformation of sawmill residues and other forest products wastes into economic resources, thus providing an opportunity for current producers to dispose of by-products in an economic and environmentally sound manner.

SOMMAIRE

1. Une centrale d'une capacité de 25 MW a été choisie. La quantité de résidu de bois (combustible) disponible dans un rayon de 100 km du site proposé dépasse largement les besoins de la centrale.

   La capacité de 25 MW est favoriseé en se basant sur les points d'appui suivants:

   i) le combustible supplémentaire requis par une plus grande centrale devrait être récupéré à partir des broussailles au bord de la route; ceci est un élément ayant un coût relativement élevé.

   ii) le système proposé tient compte des livraisons du combustible sur une période de 8 heures par jour. Il serait nécessaire de doubler les moyens de réception, de manutention et d'entreposage de jour du bois pour accommoder une augmentation supplémentaire de la capacité de la centrale. Comme alternative, il serait possible de recevoir le bois sur une base de 2-postes. Ceci mènerait à un accroissement du personnel de la centrale d'énergie avec une augmentation en coût estimée à 100,000$ par année.

   iii) la turbine proposée à 25 MW se situe à l'extrême supérieur de la gamme modulaire et une augmentation de la grandeur résulterait en une augmentation disproportioneé des coûts.

   Il est recommandé que, étant donné la position favorable de la disponibilité du combustible au bois, une étude plus détaillée soit faite pour une plus grande capacité de la centrale.

   Comme guide à la commission, une base de données a été développée et apparaît dans l'Appendice IV. En examinant ce guide, une considération devra être portée sur les points suivants:

   - Bien que le combustible au bois, basé sur nos investigations récentes, est disponible en quantité suffisante pour une centrale de 50 MW, le coût augmentera et la fiabilité d'approvisionnement diminuera. Ces facteurs impliquent un risque supérieur pour les investisseurs potentiels.

   - La centrale opèrerait à des conditions de vapeur supérieures avec une amélioration de l'efficacité globale de celle-ci; ceci serait probablement contrebalancé par le coût supérieur pour le combustible au bois.

   - Tel que mentionné plus tôt, les livraisons du combustible nécessiteraient plus de 80 chargements par période de 8 heures par jour, lesquels peuvent être choquant pour la communauté.

2. Une location tentative fut choisie dans la région de Kedgwick pour la centrale d'énergie à combustible au bois.

   i) c'est une région centrale pour de grandes quantités de résidus de bois venant des opérations de transformation du bois ansi que de la récolte du bois.

   ii) il y a un grand moulin-à-scie ainsi que d'autres usines de transformation du bois près du site favorisé, lesquels pourraient fournir une portion du combustible et peuvent possiblement vouloir acheter de la vapeur venant du cycle de la turbine.

   iii) le site est tout près d'une ligne à haute tension, propriété de Énergie NB.

3. Dans la région de Kedgwick, il y a 3 sources de résidus de bois qui peuvent être utilisées comme combustible pour une centrale à combustible au bois. Elles sont:

   i) résidus des usines de transformation du bois

   ii) résidus (bois dur) des résidus forestiers au bord de la route

   iii) résidus (bois mou) des résidus forestiers au bord de la route

   Ces sources sont énoncées dans un ordre de coût croissant.

   Il est important de noter que les moulins qui utilisent maintenant du cèdre comme source de fibres n'ont pas toujours un marché pour les résidus résultant de leurs opérations. Il est difficile de transformer l'écorce du cèdre en combustible, et les copeaux possèdent un ratio "Btu à volume" faible. Certains opérateurs indiquent que si un moyen économique pour disposer des résidus n'est pas trouvé, il ce peut que leur usine doive fermer ses portes. Dans cette étude, l'utilisation des résidus de cèdre est prise en considération, tel que mentionné par les opérateurs.

   Nos résultats indiquent que:

   i) pour un facteur de capacité de 50% sur l'unité de 25 MW et un approvisionnement de vapeur à un moulie-à-scie voisin, il y a une réserve adéquate de résidus de moulin.

   ii) pour un facteur de capacité de 80% et le même approvisionnement de vapeur, il sera nécessaire d'utiliser tous les résidus de moulin tels qu'indiqué, de même qu'une portion seulement du résidu forestier de bois dur.

iii) pour un facteur de capacité de 90% et le même approvisionnement de vapeur, il sera nécessaire d'utiliser tous les résidus de moulin plus seulement une portion du résidus de bois dur et de bois mou qui est économiquement récupérable.

4. Un design conventionnel d'une centrale est proposé. Celui-ci comprendra des équipements de condensation pour les gaz d'échappement de la turbine, mais avec un approvisionnement en vapeur pris à un point d'extraction sur la turbine pour approvisionner les besoins totaux en vapeur d'un moulin-à-scie voisin.

5. L'estimation du coût de la centrale et de l'équipement (25 MW), en dollars 1990, est de 66,000,000$. Ce montant comprend une allocation pour l'intérêt durant la construction.

Les coûts d'opération sont également estimés en dollars 1990 et comprennent une allocation qui augmente de 4% par année.

Les coûts pour l'énergie et pour la vapeur sont démontrés pour l'année 1994, en supposant que l'année 1994 soit la première année.

6. La centrale aurait un personnel d'opération de 30 employés. Les emplois crées par l'approvisionnement de combustible au bois, incluant le transport de résidus, sont estimés à 45. Ceci résultera donc en un total de 75 personnes employées directement pour l'approvisionnement du combustible au bois et pour les opérations de la centrale.

7. Trois (3) états pro forma ont été développés (référence en Appendice III); l'illustration de base démontre une centrale ne recevant aucune assistance du gouvernement mais recevant le total de ses fonds du privé; le second démontre une subvention pour 50% du total des coûts en capital; et le troisième démontre le prix qui devrait être payé pour l'énergie de façon à atteindre le seuil de rentabilité. Les références doivent être faites selon les données du facteur de capacité de 90%.

L'illustration de base démontre que la centrale d'énergie génère des flux monétaires négatifs durant sa durée de vie de 20 ans. Ceci prouve donc être un investissement peu attrayant. L'analyse du scénario de la subvention de 50% démontre que la centrale d'énergie génère un flux monétaire positif durant sa durée de vie de 20 ans, et un retour d'impôt sur investissement en capitaux propres d'environ 11.7%. Le troisième état démontre que le prix facturé pour l'énergie durant la première année d'opération serait de 10.5¢ par kWh afin d'atteindre le seuil de rentabilité, après une allocation de 20%.

8. Des trois (3) scénarios de financement examinés, seulement deux; celui comprenant la subvention de 50% et celui comprenant l'augmentation du revenu de la vente d'énergie, résultent en un paiement d'impôt sur les corporations.

   Les paiements de taxes de la corporation pour les 20 premières années d'opération pour le facteur de capacité de 90% sont:

   1. l'option de la subvention de 50% se totalise à 3,380,000$ lorsqu'il est escompté au taux d'intérêt préférentiel basé sur l'année 1994, en supposant que celle-ci soit la première année d'opération. Un taux préférentiel de 14% est supposé.

   2. l'option qui alloue une augmentation des revenus venant de la vente d'énergie se totalise à 7,785,000$ lorsqu'il est escompté au taux d'intérêt préférentiel basé sur l'année 1994, en supposant que celle-ci soit la première année d'opération. Un taux préférentiel de 14% est supposé.

9. L'opération de la centrale d'énergie résultera en 75 emplois à temps plein, dont la plupart seront associés à l'approvisionnement et au transport du combustible au bois. Après avoir pris en considération l'impact indirect sur les emplois, de même que pour les emplois déplacés, le projet résultera en une augmentation nette de 67 emplois provinciaux. L'impact net sur le revenu provincial est estimé à $3.2 million annuellement.

   Certains impacts positifs significatifs comprennent la transformation des résidus des moulins-à-scie et d'autres pertes de produits forestiers en des ressources économiques. Ceci procure donc une opportunité pour que les producteurs actuels puissent disposer de leurs sous-produits de façon économique et environnementallement sûr.

1.0 INTRODUCTION

During the last twenty years, the price of oil has risen substantially and in order to reduce the effect of this on the economy, consumers have, in many instances, converted all or a portion of their thermal energy needs from oil fuel to wood fuel.

The intent of this study is to examine the economics and the socioeconomics of a wood-fuelled power generation plant in the Kedgwick/St. Quentin area of New Brunswick.

Such a venture would consume large quantities of wood residue, and would provide benefits to the Restigouche region and the Province such as:

(1) The employment generated by such a facility is considerably greater than that for an oil fuelled plant;

(2) The resource is local and renewable and, through its use, the money spent remains in the region;

(3) The emissions from wood fuel are cleaner than for oil or coal in that the sulphur emissions in the exhaust gas streams are lower and the particulate levels can be readily reduced to permissable levels through use of proven dust-collecting equipment; and,

(4) Improvement in provincial balance of payments due to lower imports of oil and electric power.

The wood fuel for the plant could be supplied from three sources:

(1) wood processing plants residue, providing the operators with a source of revenue for a product which would otherwise cost them money for disposal;

(2) from forest residue consisting of: limbs, tops, dead or dying trees, fallen trees and nonmerchantable species which, on being reclaimed, provide income for the operator and the added advantage of cleanup such that site preparation for reforestation is reduced or not required. This is a distinct plus in the overall forest management of stands; and,

(3) from dedicated stands where, at the present time, there is a surplus of hardwood. This may be reduced should more pulp and paper mills make use of it, however, the present actual consumption is well below the allowable annual cut (AAC). The surplus could be available as a sustainable volume for use on the highest value-added product which, at the present time is fuel. For this study, it appears that the cost of fuel from this source is relatively higher than other sources and has not received any further consideration.

The plant capacity was to be selected based on wood fuel availability. The following options were to be considered:

(i) a stand-alone plant utilizing a full condensing cycle; and,

(ii) a cogeneration plant in which the exhaust steam is gainfully used for an industrial process or other heating requirements.

The cogeneration options would require a very large steam consumer near the power plant. Our investigation of steam consumers in the central area of Restigouche County indicates that no such loads presently exist.

There is, however, a steam demand by one or more of the sawmills in the Kedgwick area which could readily be supplied from an extraction point on the turbine. This provides us with a partial cogeneration system which, in turn, provides benefits to local industry while at the same time, contributing to the generation of electric power. This approach will be used in the study to follow.

2.0 OBJECTIVES AND METHODOLOGY

The objectives of the study are:

- To examine the costs of a "stand-alone" wood-fuelled electric power plant and compare the costs to the avoided costs of NB Power.
- To examine both the economic and socioeconomic cost/benefits of the "stand-alone" wood-fuelled electric power plant.
- To examine the costs of a "cogeneration" wood-fuelled power plant, assuming such a cogeneration facility is feasible, and compare the costs to the avoided costs of NB Power.
- To examine both the economics and socioeconomic cost/benefits of a "cogeneration" wood-fuelled power plant, assuming such a cogeneration facility is feasible.
- To evaluate and recommend specific area locations as they relate to "stand-alone" and "cogeneration" and as they relate to the tie-in with the NB Power transmission grid.
- Examine new industry opportunities related to the availability of steam.
- Identify and evaluate compatible sources of fuel such as municipal waste.

The following methodology has been used to achieve these objectives:

2.1 ADI Limited has completed in excess of 20 wood-fired projects and the experience and data gained from these projects has been utilized on this project as appropriate.

In addition, considerable work has been undertaken in the State of Maine on the development of power generation stations using wood as primary fuel. We have a good relationship with some of the plant operators and as a result, have access to good operating data. Use has been made of this data as appropriate.

2.2 Data relating to the fuel availability has been drawn from the New Brunswick Department of Natural Resources and Energy, as well as data available from our own files and discussions with mill and harvesting contractors in the area.

2.3 Capital and operating costs have been developed from our work on other similar projects and from information from equipment suppliers for the major components of the plant.

The financial evaluations have been developed for a stand-alone plant of a size compatible with fuel availability at a reasonable cost and with load factors of 80% and 90% to demonstrate the advisability of operating at as high a load factor as possible. The evaluations take into consideration the up-to-date information on tax incentives which may be available to the project given certain ownership approaches.

2.4 A check of steam consumers in the area central to wood fuel supply indicated loads in the order of 30,000 to 50,000 pounds/hour (13,600 to 23,000 kg/hour) which can readily be supplied from an extraction point off the turbine. This will permit more efficient use of a portion of the steam as required for the generation of electric power.

2.5 Costs are stated in 1990 dollars.

2.6 Discussions have been held with representatives of the Department of Environment on the methods proposed for handling the liquid, solids (ash) and gaseous discharges from the plant.

2.7 Preliminary discussions only, have been held with regard to plant location. A best effort has been made to select a location which is:

(i) central to the wood supply;

(ii) readily accessible from year around highway;

(iii) in proximity to NB Power transmission lines, an adequate water supply, servicing facilities and personnel;

(iv) near an operating facility, existing or proposed, having need for steam energy as part of the cogeneration options.

The selection takes into consideration present industrial alignment. The longevity of this industrial base may be influenced by external trade patterns, and the effect of fire, disease or insect attack on the forests, all of which is beyond the scope of this study.

2.8 The report does not identify new industrial opportunities since such an examination is beyond the scope of the study. It does, however, make provision for the extraction of steam from the turbine which may be supplied to industry at costs lower than would be available from other fuels. The present allowance provides for a steam delivery of 50,000 pounds per hour (22,600 kg/hr) at 50 PSIG (345 kPa). This amount should be checked prior to the preparation of boiler and turbine specifications.

2.9 The socioeconomic analysis portion of the report has been taken from an earlier study to determine the estimated indirect employment generated from the project (and other benefits).

2.10 With reference to the use of municipal waste, our firm has concluded several studies on the subject of municipal waste incineration. From these, it is apparent that the capital costs of such a facility will be from 1½ to 3 times that of a conventional plant. In addition, there are large quantities of ash and residue from the combustion process, as well as objectionable gaseous discharge from the stack. For these and other related reasons, it was agreed by the committee that no further consideration be given to the use of municipal waste as a fuel.

2.11 The transportation data has been developed from actual costs available from current deliveries of wood fuel. Allowance is made in the plant design for handling stick wood, as well as residue, resulting from the wood processing operations.

3.0 WOOD FUEL AVAILABILITY

This section of the report examines the supply of wood residue from three sources: (1) from harvesting operations; (2) from wood processing operations; (3) from surplus or non-merchantable species (dedicated stands).

The following describes briefly the residue form, its characteristics and volumes available for each of the 3 sources within license areas 1 and 10 and parts of 2 & 9. These areas only are applicable to the study since the delivery of the wood fuel (residue) would not prove economical over a distance exceeding 100 km.

3.1 Wood Harvesting Operations

The harvesting operations in the Province are conducted under two administrative units. These are: (1) Crown Licensees and Sub-Licensees; and (2) Marketing Boards. The boundaries used in this report are those of the Crown Licensees. The two licensees are: NBIP Forest Products Inc. with the Upsalquitch (#1) license and the Fraser Inc. with the Restigouche-Tobique license (#10). Reference the Crown Timber Boundaries contained in Fig. 3.1.1 following. The boundaries for the various Marketing Board regions do not correspond with those for the Crown licensees. In order to obtain a reasonably accurate correlation with the licensee boundaries, we have used all data as reported for the Marketing Board regions in the North Shore (NSH), Madawaska (MAD), and some of the data for Carleton-Victoria (CVC) and Northumberland (NTH). Reference the Marketing Board boundaries as contained in Fig. 3.1.2 following.

In recent discussions with persons responsible for harvesting large volumes of timber in the region, it was learned that much of the harvesting is performed on the "whole-tree-to-roadside" basis with the limbs and top left as residue at roadside. This includes the softwood (SW) component which is used as the primary input to their manufacturing process and in addition, the hardwood (HW) much of which is removed to facilitate restocking of the stand. At the present time, the SW residue is disposed of by controlled burn or by spreading over part of the stand. A portion of the HW is used by residents of the region as fuel wood, but much is left in the stand. These two waste streams represent large volumes which could, if costs for recovery, processing and transport are reasonable, be used as wood fuel in the Power Station.

The Marketing Boards administer the cutting in all non-industrial woodlots. The Forest Products Commission monitors the operation of the Marketing Boards and maintains a record of all wood contracted for, and delivered by each of the marketing boards.

Table 3.1.1 following has been developed from data contained in the latest issue of the Timber Utilization Survey for the year 1988. This survey was produced by the Department of Natural Resources and Energy, Province of New Brunswick.

The table provides a summary of all roundwood harvested beginning April 1, 1988 to March 31, 1989. From this, we have extracted the data applicable to the study area. It will be noted that the table does not include in the "Totals", the quantities under "Imports" or the "Residue Volumes". The Imports have been harvested from regions outside the Province. The Residue component is in part generated outside the Province while the remainder (from N.B.) is included elsewhere as a product from the producing sawmill.

The total roundwood harvested, as reported in Table 3.1.1, is used in Table 3.2.1 to determine the roadside residue component for softwood. Where the hardwood is removed to facilitate restocking, we have obtained data on volumes directly from the operators. From the two streams SW & HW, we have developed quantities of residue (in green tonnes) which may be recovered for use as a fuel. the factors used in converting from roundwood (m^3) to green tonnes of residue are contained in Appendix 1. This table also records the quantities of mill residue (only the portion "not committed").

Table 3.1.1
Summary of Roundwood Harvested During 1988 in Cubic Meters (m^3)
Within License Boundaries #1 and #10 and Parts of #9 and #2

COMPANY NAME	MARKETING BOARDS			FEDERAL LAND	OWN FREEHOLD	INDUSTRIAL FREEHOLD	CROWN LICENSE				IMPORTS	RESIDUE VOLUME		TOTAL ROUNDWOOD EXCLUDING IMPORTS
	NAD	NSH	CVC				#1	#10	#9	#2		IMPORTED	N.S.	
Robert Nadeau: St. Q														0
Les Bois Carres: St. Q														0
Plancher Heritage: Kedg														0
Belanger Lumber: Athol							43,239	16,648						59,887
Cedre Restigouche: St.Q		4,000				19,436	24,632	24,703		2,966				75,737
Savoie & Sons: St.Q						487	185	4,983		428		156,131	567,863	6,083
Fraser Edmundston	258,146				17,287	25,501		192,983	9,549		4,958	391,105	311,034	503,466
Fraser Kedgvick		1,383						84,727						86,110
Fraser Plaster Rock	36		4,876		314,338		12,217	141,133						472,600
JD Irving Veneer Siding					84,546						30,652			84,546
J.D. Irving St. Leonard					122,550						53,035			122,550
Kedgvick Lumber						1,200	4,492	4,061						9,753
Lattes Balmoral Ltee		4,000					12,000							16,000
LaClerc et Freres	408					3,669								4,077
N.American Forest: SH		17,920				17,679	5,510	69,908		32,656				143,673
N.American Forest: Shin						5,989	660	2,852		1,302				10,803
NBIP		87,186		421			353,363	6,510			263,256			447,480
Sciere Balmoral		800					4,950							5,750
Bordeau Cedre Atlantic						16,272	9,906	713						26,891
	258,590	115,289	4,876	421	538,721	90,233	471,154	549,221	9,549	37,352	351,901	547,236	878,897	2,075,406

* Data from Timber Utilization Survey (April 1, 1988 - March 31, 1989)

Table 3.2.1
Potential for Residue from the Forest and as Mill Residue Within the Kedgwick Region (Radius of 100 km)

(Quantities in Green Tonnes @ 50% M.C.)

COMPANY NAME	TOTAL CUT		POTENTIAL RESIDUE FROM HARVESTING Green Tonnes		SAWMILL RESIDUE Green Tonnes Not Committed	DISTANCE FROM KEDGWICK (km)
	SW	HW	SW	HW		
Robert Nadeau: St. Q.					2,000	25
Les Bois Carres: St. Q					2,000	25
Plancher Heritage: Kedg					6,000 (HW)	5
Belanger Lumber: St.Art						
Cedre Restigouche: St.Q					26,000 (HW)	25
Savoie & Sons: St.Q						25
Fraser Edmundston	503,466		302,000			100+
Fraser Kedgwick	86,110	25,000	51,700	43,500	20,000	25
Fraser Plaster Rock	472,600		283,600	45,370		35
JD Irving Veneer Siding	84,546		50,700		68,000	Avg of 70
J.D. Irving St. Leonard	122,550		73,530			Avg of 70
Kedgwick Lumber					4,200 (C)	5
Lattes Balmoral Ltee						117
LeClerc et Freres						
N.American Forest: SM					36,000	20
N.American Forest: Shin						20
NBIP	447,200	65,000 *	268,300	113,000		66
Sciere Balmoral						115
Bardeau Cedre Atlantic						
	1,716,472	90,000	1,029,830	201,870	164,200	

* Projected 1992

** Green Tonnes @ 50% Moisture Content (MC) Calculated on the Wet Basis

FIGURE 3.1.1 CROWN TIMBER LICENSE BOUNDARIES
IN NEW BRUNSWICK

FIGURE 3.1.2 FOREST PRODUCTS MARKETING BOARDS
IN NEW BRUNSWICK

3.2 Wood Fuel from Wood Processing Plants

All operations that process roundwood produce some form of residue as a by-product and these by-products may or may not be further utilized to form a saleable product. As an example, a sawmill produces lumber as its primary product and generates chips, shavings, sawdust and bark as by-products. The chips represent a marketable product used in the manufacture of paper, the remainder has, in the past, been considered a waste which had to be burned in an on-site teepee burner or transported to some landfill. These disposal means are no longer acceptable and in the best interest of the mill operator, it is desirable to develop some means whereby the products can be gainfully utilized. The materials are available at a moisture content of from 40% to 60% (wet basis) which is suitable for burning in modern combustion chambers, usually associated with a boiler.

A questionnaire was directed to wood processing plants in the region to determine the quantities of residue presently available for use in the proposed wood fired power station. The results obtained from the questionnaires and follow-up discussions with operators have been recorded in Table 3.2.1. It should be noted that much of the current residue from mill operations is "committed", the table lists only the quantities confirmed as "available".

3.3 Wood Residue from Surplus Stands

The harvesting of low grade stands, or non-merchantable stands such as poplar or other species of hardwood for fuel can best be accomplished by the whole-tree system. This involves cutting the tree, probably by chain saw, and transporting the whole tree to roadside by skidder or farm tractor or possibly by some form of transporter which has the advantage of keeping the product clean (free of mud, ice, rocks, etc.). Clearly, all costs are chargeable against the only product produced, namely, fuel chips. However, because the percentage of stemwood is much higher than when only residues are processed, costs per unit of output of chips are lower than for chips produced at the stump or in "clean-up" operations, but higher in cost than the forest residue processed from the roadside residue (Refer to Section 3.1). The trimming and thinning operations forming part of the silvicultural activity for a stand of good quality stock is a further source of wood residue. The cost of this residue may be high depending on the portion that is credited to silviculture.

Given that there is a relatively large quantity of residue available from the present harvesting operations and further; given the relatively higher price for residue from surplus stands, it is concluded that reference to this source is not necessary at this time. The prices obtained from enquiries range from a low of $30.00 to a high of $35.00 per green tonne.

3.4 Summary of Wood Fuel Available

Reference Table 3.2.1; quantities have been developed (green tonnes) for residue available from the harvesting of roundwood in the region. Further, quantities of mill residue, only the component not already committed, have been developed following discussions with mill operators. The residue available has been summarized in Table 3.4.1 following.

It will be seen from the table that:

.1 The quantity of mill residue is less than expected because large amounts are already committed to other energy consumers. Where available, this source is favoured since it presents the lowest cost.

.2 As noted, there are large quantities of harvesting residues which can readily be recovered and processed for use as fuel. The cost of this residue delivered is higher than mill residue. In order to meet the fuel needs of the proposed power station, much of the requirements must be provided from this source. The softwood component, as noted earlier, consists mainly of tops and limbs from the harvesting of timber as required for wood processing operations in the region including pulp and paper, sawmills, both shingles and flooring.

The hardwood component is removed from the stand such as to facilitate restocking. For the most part, it is not used in processing operations and as such, the whole tree is available as residue.

In considering this source, it would be prudent to bear in mind that while at the present time, the demand for hardwood as a feed to paper mills and other primary processing plants is low, this could change leaving us with the softwood residue only. The softwood will have a slightly higher energy content, but this is largely offset by the higher cost of handling and processing. For this report, we have given priority to the lower cost hardwood.

Table 3.4.1
Summary of Wood Fuel Availability
Within 100 km of Kedgwick

Quantities in Green Tonnes @ 50% Moisture Content

Forest Residue SW *	Forest Residue HW **	Mill Residue +	Plant Requirements at Capacity Factors ++ 50%	80%	90%
1,029,800	201,870	164,000	162,000	245,000	273,000

* Based on Timber Harvest as Reported in Timber Utilization Survey - 1988

** Based on Discussions with Operators

\+ Based on Questionnaires & Discussion with Operators (Non Committed Only)

++ Based on kWh outputs as reported in Table 7.6.2.2 & steam deliveries to adjacent sawmills.

4.0 WOOD FUEL COSTS

At this point in time, suppliers are reluctant to commit themselves to quantities or prices. However, from discussions with persons involved in the processing and transport of residues, we have learned the following:

4.1 Sawmill Residue

The cost loaded on a trailer (van) at the mill will vary from $3.00 to $4.00 per green tonne. In this report, we have provided an allowance of $4.00 per green tonne.

4.2 Forest Residue

This residue is located at roadside from the "whole-tree" harvesting system. As noted earlier, this system is employed by most operators in the region. The following costs are considered realistic for the softwood slash and the hardwood whole-tree recovery and processing.

4.2.1 Softwood

The residue from the softwood harvest consists of tops, limbs and rejects. An allowance of $17.00 per green tonne has been provided for the: (1) recovery of the residue from roadside, (2) chipping of the residue, and (3) loading on a transport vehicle.

4.2.2 Hardwood

The hardwood is cut and taken to roadside such as to clear the stand and prepare it for restocking. The hardwood is not presently used by the mills and may all be used as fuel. This residue will generally be recovered, processed and loaded at a lower cost than the softwood residue since it is essentially a "whole-tree" chipping operation as compared to the limbs and tops only for the softwood component. An allowance of $14.50 per green tonne has been provided for: (1) full tree recovery from roadside, (2) chipping, and (3) loading on a transport vehicle.

4.3 Transport

The transport assumes that for large volumes, 45 ft to 53 ft trailers will be utilized. Arrangements will be made at the Kedgwick Power Plant for a dumpster type unloader with capacity to handle trailers only with a load of 32 tonnes (35 tons). We have allowed an amount of $1.71 per round trip/kilometre for transport. For example, a trip of 100 km means 200 km travel which at $1.71/km and 32 tonnes results in a transport cost of $10.70/tonne for 100 km.

Table 4.1

Summary of Wood Fuel Costs ($1990)
Per Green Tonnes
(@ 50% MC)

Forest Residue (Cost Loaded at Roadside) SW	HW	Sawmill Residue Loaded	Transport (Typical) 50 km	100 km	Total Cost 50 km	100 km
17.00			5.35	10.70	22.35	27.70
	14.50		5.35	10.70	19.85	25.20
		4.00	5.35	10.70	9.35	14.70

5.0 WOOD FUEL QUALITY CONSIDERATIONS

The main factors in assessing the quality of wood residue as a fuel are: moisture content, contaminant level, sizing and heat content.

The moisture content of the product will vary widely, but as withdrawn from the forest it ranges from 40 percent to 50 percent (measured on the wet basis).

The moisture content (MC) of sawmill residue may vary over a much wider range depending on the process. The use of a "hot pond" ahead of the debarking operation removes the ice/snow and some of the grit, but leaves the bark with a high MC.

The use of drying kilns in the process results in a low MC for the shavings component. The product from the wood processing operations will often vary from 35 percent to 60 percent MC.

The contaminant level will vary with the system of extraction from the forest, for example, the use of "skidders" which drag the logs/trees over the ground, compared to "forwarders" which transport the logs/trees to the roadside in a container integral with the "forwarder". The subsequent handling of the product from interim storage may also be a source of contaminant pickup if care is not observed.

The wood residue from sawmills contains bark, sawdust, shavings, and some slabs. In order to have this fuel suitable for automatic feed to a boiler, it must be screened with the oversize passed through a hog or chipper. This will ensure that the product is properly sized for ease of handling and for efficient combustion.

The BTU content of bone dry (BD) wood residue will vary from 8000 to 9000 BTU per pound (18,000 to 20,900 kJ/kg). We have used 8500 BTUs/BD pound (19,800 kJ/kg), This equates with 4250 BTUs/green pound at 50 percent moisture content or 9882 kJ/kg.

6.0 POWER GENERATION OPTIONS

6.1 General Discussion

The objective is to develop details for an electric power generating facility using wood residue as primary fuel. The size (rating) of the plant would be determined from wood fuel availability on a sustained basis. The power generated would, for a plant dedicated to power generation only, be sold to NB Power. An enhanced approach would have the plant attached to or forming part of an existing industrial complex which would be a consumer of a portion of the electric power and some low pressure steam. The main power consumer would still be NB Power but the joint-use concept offers some overall gain to the industrial complex, the power plant owners and the NB Power, depending on the extent of external steam demand.

Should the steam demand be large, an even more attractive approach would be a full back-pressure power generation system which enables the sale of most of the steam passing through the turbine. The steam would be available at a pressure of 125 psi, or less, depending on the user's requirements. The big advantage in this concept is that the condensing of the steam in the steam user's plant allows for increased recovery of heat as compared to the loss realized in the condensing cycle of a conventional turbine generator.

Large steam consumers would include facilities such as kraft or paper mills. The normal industrial steam load found in our Province is relatively much smaller, such as dry kilns for sawmills or food processing plants. The preferred system for feeding such loads would include one or more extraction points on the turbine with capacity to feed the load at or near the desired pressure. This approach also offers advantages in that the steam extracted has already performed some work in the turbine. There could be a small loss of the condensate, depending on the end usage of the steam. This latter approach would seem to best meet the requirement of supplying steam to an adjacent manufacturing facility while maintaining the primary objective of generating electric power.

On the assumption that a large steam demand is not available, we have elected to proceed on the basis of a plant capable of delivering up 50,000 pounds of steam from an extraction point on the turbine.

The plant location would depend on several factors such as:

(i) a supply of fresh water;
(ii) proximity to NB Power transmission facilities;

(iii) good road access on a year round basis for large heavy vehicles;
(iv) access to staff and maintenance facilities;
(v) central as to wood fuel supply;
(vi) adjacent a steam and power consuming industry.

A sketch, Fig. 6.1, has been prepared to show in preliminary form, the layout of a conventional (stand-alone) plant. A brief description of the components is provided in Section 7.0 following.

6.2 Option Selected

In observing the factors noted above; the most central location would appear to be in or near Kedgwick. Moreover, there is in the area, a large sawmill with property adjacent and having a steam demand which could readily be supplied from an extraction point on the proposed turbine.

From a very preliminary examination, there is not sufficient water available for a water-cooled condensing cycle. It is concluded therefore that a water-to-air cooling tower approach will be required. (There will be an ample supply of water for this approach). Provision has been made for this in the capital cost estimate.

With regard to an interconnection with NB Power, there is a 138 kV line between St. Leonard and Eel River Crossing to which a connection may be made. This will require in-depth discussions with NB Power to determine:

i) the best and most suitable point for tie-in
ii) the relaying, metering and switching requirements
iii) means of control for the tie
iv) synchronizing requirements

The estimate provides for a high voltage power transformer at plant site and local switching, metering, protection and synchronizing. No allowance for transmission line beyond the plant.

7.0 PLANT DESCRIPTION

Based on the availability of acceptable quality wood fuel within a radius of 100 km of Kedgwick, and further based on discussions relating to the longevity of the supply, it is concluded that the resource will be such as to support a 25,000 kW electric power generation station.

It will be seen from Table 3.4.1 that we have identified more residue than required for a 25 MW plant. We are reluctant however to recommend a larger capacity at this time for reasons as follows:

- the fuel consumption will exceed 600 tonnes per day and if we allow for 5 day/week deliveries for 10½ months per year, the number of deliveries per day @ 25 tonnes average will be 40 plus. This is a high volume of heavy vehicle traffic in the community.

- the wood handling facilities are such that we would need to duplicate certain of the components such as dumpsters, screens, and day storage and handling.

- the 25 MW package is at the top of a modular design and any incremental increase in capacity would proportionally be higher in costs.

- with approximately a doubling in demand, the cost of fuel increases and the reliability of supply decreases.

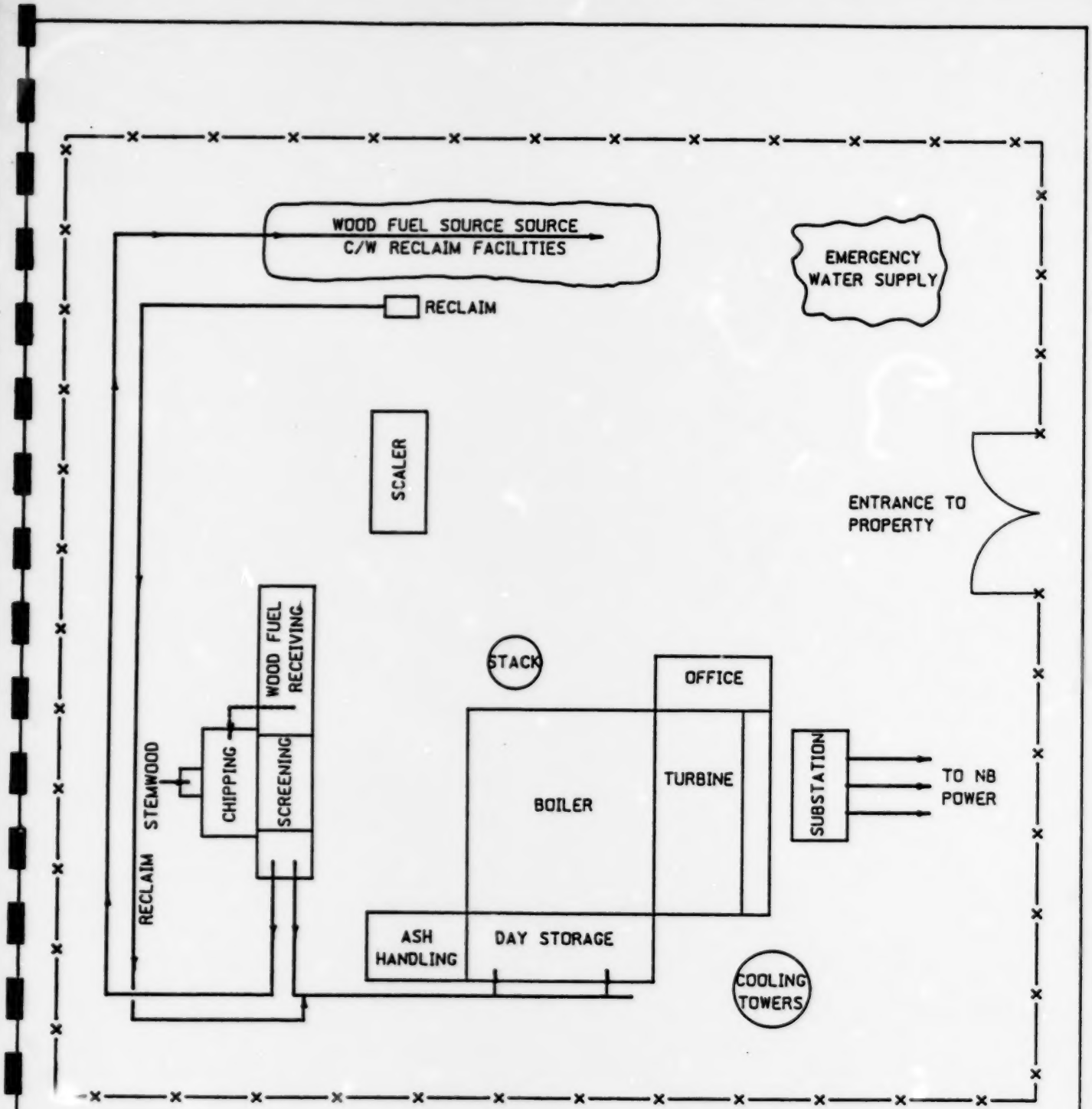
The plant would be located adjacent to a large sawmill from which a portion of the wood residue may be obtained and secondly, the sawmill will be a customer for some steam which will prove beneficial to both parties from the standpoint of cost and efficiency. The electric power will be transmitted into the grid of the NB Power system.

7.1 General Description

In general terms, the plant will have facilities as follows:

i) To receive, weigh, evaluate as to quality and volumes, all wood delivered to the plant whether in stick form or as prepared residue for direct use as fuel.

   Long term storage and handling facilities would be provided to store up to 45 days (or more if road and/or snow conditions are unfavourable for longer periods) of plant operation, and reclaim the fuel as required.



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Dwg. Title: 25 MW POWER STATION WOOD FIRED		Dwg.: FIGURE 6.1	
		Drn. By: PLM	Scale: NTS / Date: DEC/89

The normal flow would have all wood fuel passing through the screening plant (with oversize to the chipper) and the fuel directed to the day storage at the plant or to the main storage pile. The stemwood, should such be provided, would be passed through the chipper and then through the screening plant to day storage/boiler or to main storage.

ii) Wood-fired boiler complete with wood fuel feed system, travelling grate or equivalent, ash handling, air heater, economizer, superheater, fans, boiler feed system, ducting and all controls for a fully integrated system for operation at 6200 kPa, 480°C (900 PSIG, 900°F).

iii) Turbine/generator, complete with valving, hydraulic systems, lubrication system, cooling, condenser, pumps, governor, excitation system and all controls.

iv) Water handling and treatment facilities.

v) Standby/light oil fuel system.

vi) Piping, insulation and supports.

vii) Electrical switching, transformers, metering, relaying, substation and all controls and protective devices.

viii) Cooling tower, pumps and associated controls for water handling.

ix) Maintenance and servicing facilities including crane, air supply and ventilation and heating.

x) Site complete with on-site roads, sewer lines, drainage, fire protection system, paved surfaces, scales, lighting, fencing, all as required for a safe and efficient operation.

xi) Buildings and structures (foundations) to contain and support the equipment.

xii) General administration including engineering, contingency allowance, interest during construction, insurance, operating and training manuals, training program for staff and commissioning services.

7.2 Process Flow

Diagram 7.2.1 has been prepared to show the various flows for the wood-fired power station. The main inputs to the plant are: wood fuel, water, oil and air; the main outfeeds are: electric power, exhaust steam and ash. A brief description of the facilities provided is contained in Section 7.1 above.

7.3 Site Layout

Diagram 6.1 has been prepared to show the location of the major components such as to provide:

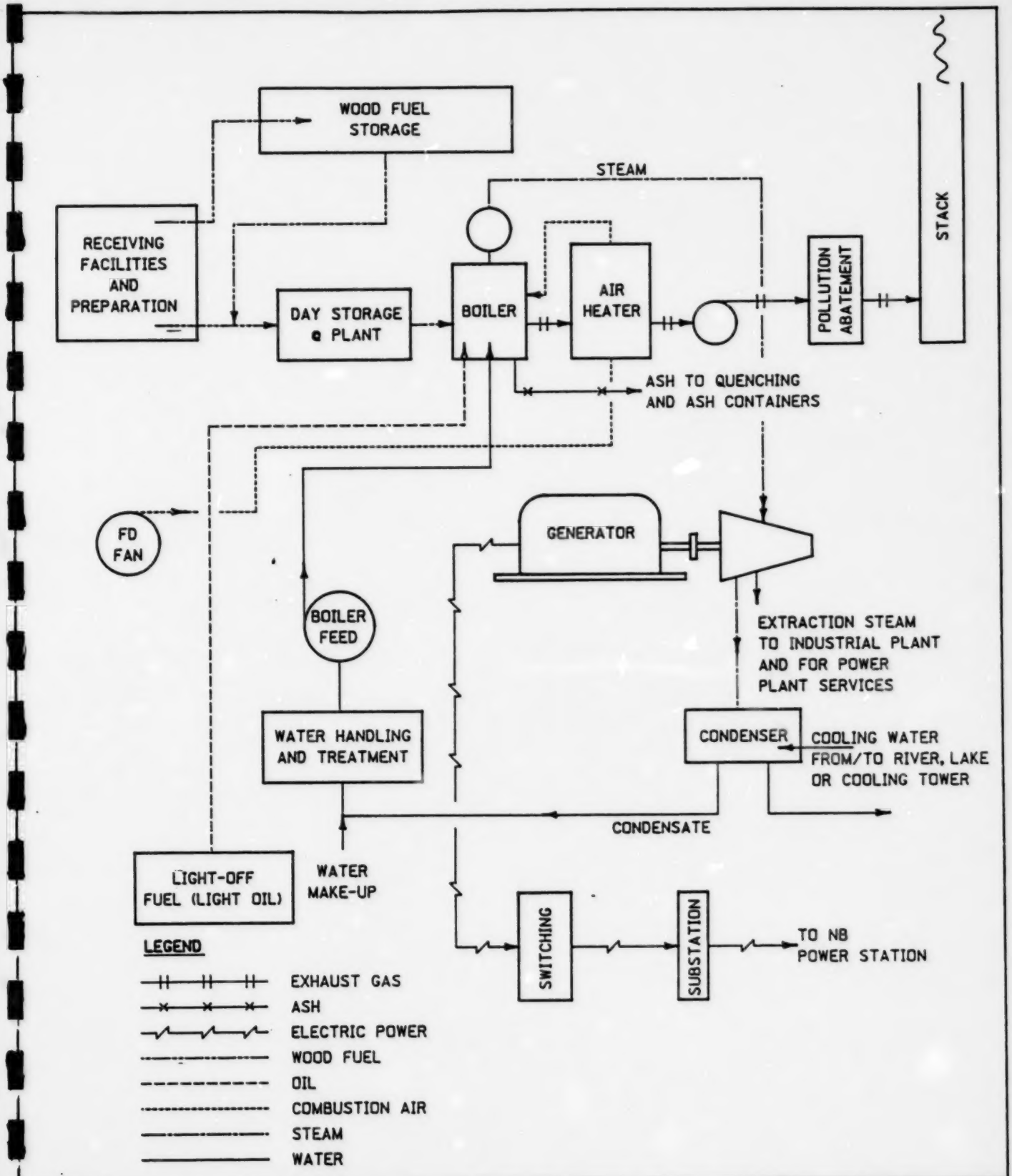
- adequate space for movement of the transport vehicles.
- substation located away from general traffic and close to switching and the generator terminals.
- wood receiving and handling facilities to provide ease of fuel transfer to long term storage or to day storage adjacent the plant.
- condensing facilities such as cooling towers and related water supply and handling.
- stack and environmental abatement equipment.
- ash storage and handling facilities.

7.4 Electrical Interconnection with NB Power

The Figure 7.4.1 following shows a typical connection for a 25 MW station. This provides for a generation voltage of 13.8 KV with transformer capacity for station service within the plant and for the primary feed to NB Power.

7.5 Environmental Concerns

There are discharges from the plant which could pose a concern; (1) products of combustion from the stack; (2) solids in the form of ash, and; (3) normal domestic sewage with incidental waste streams from the operations such as blow down, bearing cooling, etc.



Project Title
RESTIGOUCHE INDUSTRIAL COMMISSION INC.
KEDGWICK N.B.

Dwg. Title
FLOW DIAGRAM
WOOD FIRED POWER STATION

ADI Limited
ENGINEERING, ARCHITECTURE, PLANNING
MANAGEMENT CONSULTING, SURVEYING
FREDERICTON N.B. / SAINT JOHN N.B. / MONCTON N.B.
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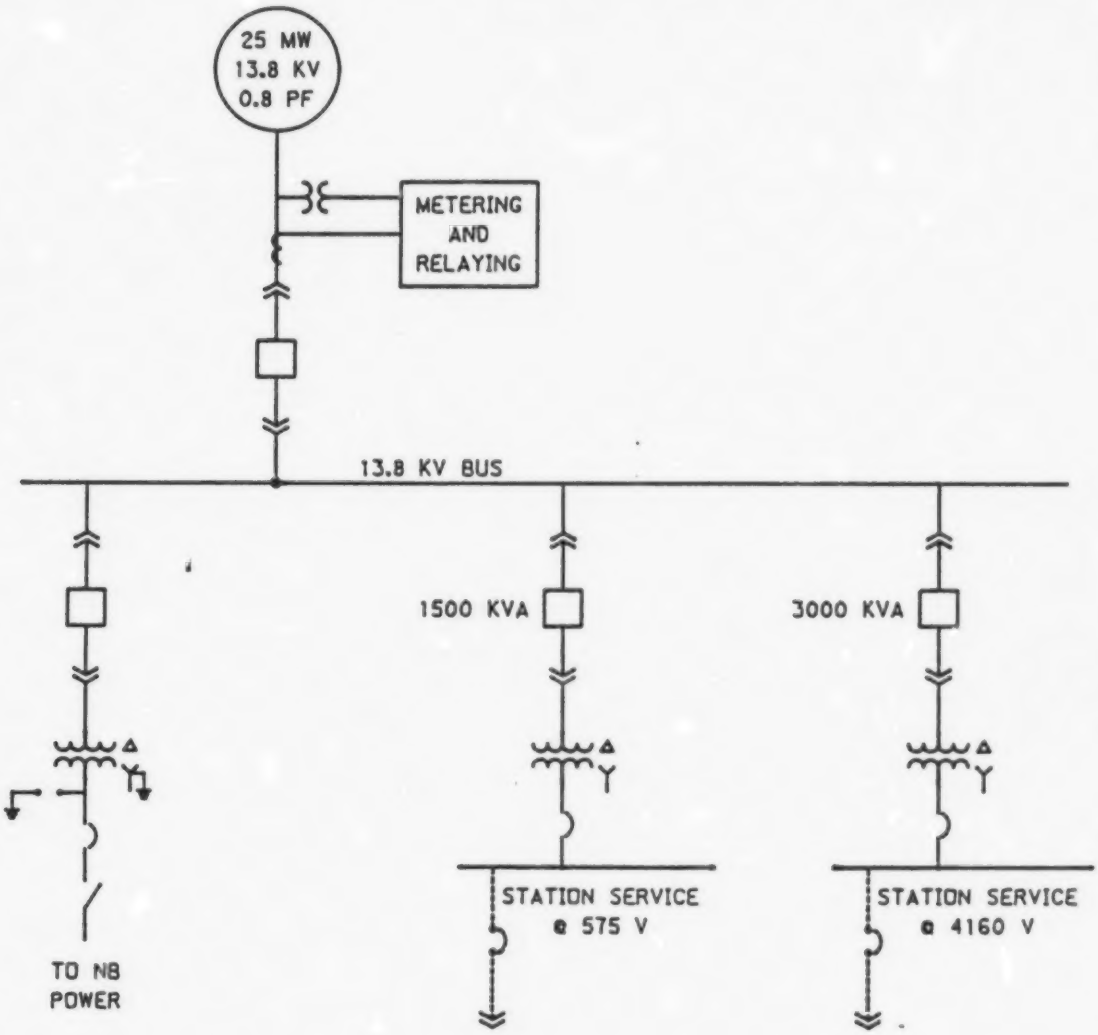
Project 2952-1

Dwg. FIGURE 7.2.1

Drn. By	Scale	Date
PLM	NTS	DEC/89



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Dwg. Title: SINGLE LINE DIAGRAM ELECTRICAL		Dwg.: FIGURE 7.4.1	
		Drn. By: PLM	Scale: NTS / Date: DEC/89

In order to comply with Environment New Brunswick regulations, we have provided the following:

1. a multi-clone would be located after the air heater and in addition, a wet scrubber system is provided for at the base of the stack; the stack will have a height of 125 to 150 feet.

2. the ash from the combustion chamber will be automatically discharged to a quenching system and then conveyed to storage bins for ease of transport to a disposal area. It will be necessary to examine dump sites, preferably in the immediate area of the plant such as to reduce the handling costs. An allowance is made for ash transport to disposal area. Reference Section 7.6.2.

   Some enquiries made on an earlier project indicated that, given certain soil conditions; the ash may be used as a nutrient supplement particularly on large farms.' More recent enquiries indicate that much of the wood ash from a large wood burning power plant in Maine is utilized in this manner. Such an approach should be investigated in detail at the project development stage.

3. the miscellaneous waste streams must be handled through an approved disposal system; the domestic sewage will be sent to a septic tank, the remainder will require some treatment and then directed to the nearby stream. Allowance is made in the estimate for some treatment of the waste streams such as blowdown.

7.6 Capital & Operating Costs

This section develops costs for the design, construction and operation of a 25 MW wood-fired power generating station using an estimated 273,000 tonnes of wood fuel per year at 50 percent MC and delivering an estimated 173.5 million kWh per year to the NB Power grid when operating at an 90 percent annual capacity factor.

7.6.1 Capital Costs

A detailed cost estimate is not possible within the scope of this analysis; typical costs for equipment and the construction of facilities will be used to provide an approximation of the expected capital requirements. Preliminary prices have been obtained from the suppliers of the two major components; the boiler plus auxiliaries and the turbine generator.

The cost estimate assumes:

i) a 25 MW power station complete, as described in the section 7.1. above;

ii) the station would be located adjacent to an existing energy consuming facility such as a large sawmill or an operation having similar energy demand, on a property of approximately 16 hectares;

iii) the site favoured does not have a suitable large water supply and we have opted for cooling towers which consume much lower volumes of water.

Based on the assumptions and materials supply, as described in Section 7 above, the capital cost is estimated to be in the order of $65,876,000 (in 1990 dollars).

The breakdown is as follows:

1.0	Site Works & Buildings	$ 9,270,000
2.0	Wood Fuel Receiving and Handling	7,263,000
3.0	Boiler and Turbo Generator	25,300,000
4.0	Electrical	5,635,000
5.0	Mechanical	6,512,000
6.0	General Administration (incl. engineering, contingency, interest during construction and commissioning)	11,896,000
	* Costs are in 1990 dollars	$65,876,000

The items most sensitive to location are; site works, the need for a reliable water supply and the length and cost of transmission line required for the transfer or power to the grid. No allowance is made in the estimate for transmission facilities as may be required from our substation to a suitable point for connection to the N.B. power grid.

The costs are typical only, supported by enquiries to boiler and turbine suppliers for estimating prices.

7.6.2 Operating Costs

It is assumed that the plant is remote from existing generating facilities and will require a full operating staff. The cost components are estimated as follows: (Reference Appendix II for details, all costs in 1990 dollars).

Staff Plant

Operating & Control	20 @ 40,000 =	$ 800,000
Administration	1 @ 50,000 =	50,000
Maintenance & Servicing	3 @ 40,000 =	120,000
Cleaning & Wood Fuel Handling	4 @ 30,000 =	120,000
Ash Handling	2 @ 30,000 =	60,000
	TOTAL	$1,150,000

Maintenance & Servicing

Supplies & Contract Work	977,000	
Ash Handling	140,000	
	TOTAL	$1,117,000

Insurance & Taxes

Insurance	75,000	
Taxes	160,000	
	TOTAL	$235,000

Wood Fuel - (Assumes Capacity Factor of 90%)

273,000 tonnes @ Avg. cost of $14.94	$4,078,400
TOTAL	$6,580,400

It should be noted that all operating costs are given in 1990 dollars. For the proforma calculations, the costs have been increased to reflect costs in Year 1 (considered to be 1994) given an annual escalation rate of 4%.

Table 7.6.2.1
Fuel Supply & Cost
(Quantities in Green Tonnes @ 50% of MC)

Capacity Factor	Forest Residue Softwood	Forest Residue Hardwood	Mill Residue	Total **	Avg.* Cost $/Tonne	Annual Cost $
50%			162,000	162,000	$12.82	2,079,000
80%		81,000	164,000	245,000	$14.44	3,539,200
90%	19,930	88,870	164,200	273,000	$14.94	4,078,400

* Avg. cost of all deliveries based on handling & processing (if required) + transport to Kedgwick Plant.

** Assumes delivery of steam to adjacent sawmill amounting to 230 x 10^6 MJ/year.

The kWh output will vary with capacity factor, the unit rating and efficiencies and the amount of power from the plant to feed the plant auxiliaries. We have estimated, as noted in Section 7.0 above, that the wood fuel supply is adequate to supply a 25 MW plant; the station service requirements would be in the order of 4025 HP, equal to approximately 3000 KW. Calculations have been made for 2 capacity factors; 80% and 90% to indicate wood fuel consumption and the power generating costs, reference Table 7.6.2.2 below. It should be noted that since financing costs and much of the operating costs are fixed, the average cost per kWh for delivered power, increases at the lower annual output.

Table 7.6.2.2
Typical Costs/kWh for Cases as Noted

Total Capacity Factor	Case	KwH Operating Costs Year 2 $ x 10^3	Cost Generated x 10^6 —	Price Required per kWh	Per kWh
90%	Base Case	18198	173.4	10.5¢	7.0¢
90%	50% Grant	13273	173.4	7.7¢	7.0¢
90%	Developed Power Cost	18198	173.4	10.5¢	7.0¢
80%	Base Case	17538	154.2	11.4¢	7.0¢
80%	50% Grant	12613	154.2	8.2¢	7.0¢
80%	Developed Power Cost	17538	154.2	11.4¢	7.0¢

Assumptions: Total costs are reduced by steam sales
Costs & revenue based on Year 2 only
Costs include an allowance of 20% on equity
Equity/Debt ratio of 25/75
Interest rate 14%

7.7 Revenues

Electric Power - It is assumed that all the electric power will be sold to NB Power at a rate of 7¢/kWh. This assumes that the power station will operate in a "base load" mode. The allowance of 7¢/kWh starts in 1994.

Steam - The study assumes that steam would be extracted from the turbine and sent to an adjacent wood processing plant. The price for steam has been set at $3.00/$10^6$ Btu^s net in 1994. (This includes an allowance for the return of clean condensate). Steam deliveries are estimated to be 220 x 10^9 Btu^s per year. The revenue in 1994 is $660,000.

8.0 FINANCIAL EVALUATION

Three proforma analyses have been developed; one assumes private funding without any government assistance (the base case); the second with a grant in the amount of 50% of the total capital costs; and the third based on developed costs for the power.

The analyses were prepared based on the following assumptions:

i) Capacity Factors of 80% and 90%.

ii) An economic life of 20 years.

iii) A salvage value of zero.

iv) An average fuel cost of $15.00 per green tonne (@ 50% MC) delivered to the power plant for 90% capacity factor and 14.50 for the 80% capacity factor.

v) The fuel consumption and electric power have been reduced in Year 1 to allow for problems which may arise during the commissioning and run-in period.

vi) The capital cost is estimated to be $66,000,000. Operating costs are as noted in Appendix II of the report.

vii) The interest rate on money borrowed is 14%.

viii) A corporate tax rate of 45% has been applied.

ix) In the base case, the capital cost of the project is funded as follows:

25% from private investors
75% from loans (20 years at 14% interest)

x) For Capital Cost Allowance (CCA) purposes, it is considered that 50% of the capital assets (those related to the boiler, etc.) will qualify as Class 34 and thus be allowed an accelerated write off. The remaining 50% of capital assets (those related to the turbine, etc.) will qualify as Class I assets.

The detailed results of the analyses are presented in Appendix III.

In order to improve the cash flow to the point of generating a rate of return that will attract private investment, it will be necessary to either increase revenues or reduce costs. It is considered that the price received for power is not open to negotiation, and that cost reduction is the most likely method of improving the financial performance of the plant. A "50% grant case" has been prepared to show the financial impact of government assistance in the form of a grant for 50% of the project's capital cost. The "developed cost" for power indicates the price required for the power in order to meet the "break even" scenario.

The "developed cost" is an alternative to the "grant" approach and would, in effect, represent a subsidy on electric power.

The subsidy approach would provide an annual payment equal to the difference in revenue using the given NB Power rate and the "developed power cost".

A further consideration would be a reduction in the cost of fuel. In many instances, the residue from the wood processing or harvesting operations must be disposed of in an environmentally suitable manner. This invariably results in some costs which are charged against the operation's products. Some consideration may be given to using a portion of that cost to effect a reduction in the price of fuel. This represents a sharing of benefits resulting from gainful use of the residue as a fuel. This approach would also require a detailed examination and in-depth discussions with residue (fuel) producers.

Further analyses to show the sensitivity of the project to variations in the basic assumptions were carried out as follows:

i) capital cost - ± 10%
ii) fuel costs - ± 10%
iii) interest rate - ± 2%

The results of these sensitivity analyses are presented in Appendix III.

9.0 SOCIO ECONOMIC IMPACTS

9.1 Introduction

The evaluation of the Socio-Economic Impacts examines the economic activity resulting from the project, the offsetting displacement impacts, and other associated impacts such as savings associated with sawmill residues and increased value of existing timber stands.

9.2 Economic Impacts

The direct economic impacts have been identified for both the construction and operational phases of the project.

The total construction cost for the project is estimated at $66 million. However, this positive impact will be offset by negative impacts elsewhere in the Provincial economy because the construction of this plant will mean that 25 MW of capacity will not be required elsewhere in the NB Power system.

The operational phase of the project will result in an annual expenditure of approximately $6 million, the majority of which is associated with the supply of wood fuel. This expenditure translates into a $6.2 annual contribution to the provincial income. In terms of employment generation, the direct employment for the project is estimated at 75 fulltime jobs, 30 for the plant operation and 45 for the supply and transportation of fuel. Applying the employment multiplier from the NBwesplan model, the total employment impact is estimated at 116 jobs.

9.3 Displacement Impacts

The construction of the plant is assumed to displace the requirement for electrical generation elsewhere in the NB Power system. The impact of this displacement was examined in a previous project undertaken by the Provincial Government [1]. In that study, a wood fired electrical power plant was assumed to displace 25 MW of coal fired capacity fuelled 50 % by N.B. coal and 50% by imported coal. The total displaced jobs was estimated at 49 per year and a corresponding loss of annual income of $3 million.

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[1]Report On A study of Power Generation From Wood Fuel: A preliminary Feasibility Study, N.B. Department of Natural Resources and Energy, September 1987.

9.4 Other Socio-Economic Impacts

The disposal of sawmill residues and roadside slash has become a critical environmental and economic issue for the forestry industry. The proposed plant will provide an environmentally attractive solution for this problem. Currently, the disposal of these byproducts represents a cost to the operators of approximately $8 per tonne. The proposed plant has the potential to convert these byproducts from an associated cost of $8/tonne into a net revenue of $3 to $4/tonne. Based on an annual requirement of 245,000 tonnes of fuel this represents a benefit of $750 thousand to $1 million annually.

9.5 Summary

The proposed plant will provide a net positive economic impact on the region and the province in terms of employment and income. The calculation of the net economic impact presented below.

	Direct	Indirect	Total
Employment Generation			
- plant operation	30	16	46
- wood supply	45	25	70
Employment Displacement	37	12	49
Net Employment Impact	38	29	67
Income Generation			$6.2
Income Displacement			$3.0
Net Income Impact			$3.2

The disposal of sawmill residues, roadside slash and unwanted hardwood trees represents a significant environmental and economic benefit.

APPENDIX 1

Harvesting Residue Assumptions

Dedicated Stands Residue Assumptions

Appendix I

Harvesting Residue Assumptions

(1) 1 m^3 of hardwood = 1.04 green tonnes (0.52 BD tonnes)

(1) 1 m^3 of softwood = 0.87 green tonnes (0.44 BD tonnes)

Hardwood harvest is 19% of the Provincial total

Softwood harvest is 81% of the Provincial total

Therefore, weighted average = 19% x 1.04 = 0.20

81% x 0.87 = 0.70

0.90 green tonnes

m^3 (solid) of roundwood = .90 green tonnes

(2) If 60% is stemwood = 0.9 green tonnes/m^3 (solid) stemwood

(2) Then 40% is residue = 0.6 green tonnes/m^3 (solid) stemwood

Assume 50% M.C. (wet basis)

Therefore, 0.3 BD tonnes of residue is generated for each m^3 (solid) harvested.

Note: This applies to slash only at roadside--it does not include any stemwood.

(1) Reported values in commercial use: Valley Forest Products Ltd.

(2) Ker, M.F., "Biomass Equations for Seven Major Maritimes Tree Species", Maritimes Forest Research Center, Information Report M-X-148.

Surplus Stands

For hardwood (whole tree) (2) 60% is stemwood = 104 green tonnes/m^3
(solid) stemwood

(2) 40% is residue = 0.70 green tonnes/m^3
(solid) stemwood 1.74 green tonnes

= .87 BDT/m^3 (solid)

stemwood (or roundwood)

Since AAC* figures are based on stemwood (or roundwood) volume, we conclude that each m^3 (solid) of hardwood AAC would yield .87 BD tonnes of whole tree chips.

For softwood (whole tree) (2) 60% is stemwood = 0.88 green tonnes/m^3
(solid) stemwood

(2) 40% is residue = 0.58 green tonnes/m^3

(solid) stemwood = 1.46 green tonnes
= .73 BD tonnes/m^3

(solid stemwood)

*AAC = Annual Allowable Cut

(1) Reported values in commercial use: Valley Forest Products Ltd.

(2) Ker, M.F., "Biomass Equations for Seven Major Maritimes Tree Species", Canadian Forestry Service, Maritimes Forest Research Center, Information Report M-X-148.

APPENDIX II

Estimate of Operating Costs

Appendix II

Preliminary Estimate of Operating Costs For Typical 25 MW Power Station

1. Staff

Shift Operators	20 @ 40,000	=	$ 800,000
Plant Superintendent	1 @ 50,000	=	50,000
Maintenance & Servicing (1 MW, 1 Elect, 1 Piping)	3 @ 40,000	=	120,000
Cleaning & Wood Fuel Handling	4 @ 30,000	=	120,000
Ash Handling	2 @ 30,000	=	60,000
	TOTAL		*$1,150,000*

2. Maintenance & Servicing

c/w Supplies & Contract Labour	$ 870,000
Ash Handling @ 80% LF	125,000
Costs for 80% Load Factor	$ 995,000
Costs for 50% Load Factor	630,000
Costs for 90% Load Factor	1,117,000

3. Insurance & Taxes $ 335,000

APPENDIX III

Summary of

Proforma Analyses

and

Sensitivity Analyses

CAPACITY FACTOR	80%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$14.50
CAPITAL COST	$66,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 K.V. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT NO GOVERNMENT ASSISTANCE IS RECEIVED

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.070 per KWH	$8,631	$11,118	$11,451	$11,795	$12,149	$12,513	$12,889	$13,275	$13,674	$14,084	$14,506	$14,941	$15,390	$15,851	$16,327	$16,817	$17,321	$17,841	$18,376	$18,927
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$9,291	$11,798	$12,152	$12,516	$12,892	$13,278	$13,677	$14,087	$14,510	$14,945	$15,393	$15,855	$16,331	$16,821	$17,325	$17,845	$18,380	$18,932	$19,500	$20,085
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,427	$4,322	$4,495	$4,675	$4,862	$5,056	$5,259	$5,469	$5,688	$5,915	$6,152	$6,398	$6,654	$6,920	$7,197	$7,485	$7,784	$8,095	$8,419	$8,756
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,362	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$6,211	$7,218	$7,507	$7,807	$8,119	$8,444	$8,782	$9,133	$9,498	$9,878	$10,273	$10,684	$11,111	$11,556	$12,018	$12,499	$12,999	$13,519	$14,060	$14,622
Operating income before interest, depreciation, and income taxes	$3,080	$4,580	$4,645	$4,709	$4,773	$4,835	$4,895	$4,954	$5,011	$5,067	$5,120	$5,171	$5,219	$5,265	$5,307	$5,346	$5,381	$5,413	$5,440	$5,463
Interest expense (@ 14% p.a.)	$7,109	$7,034	$6,948	$6,849	$6,735	$6,604	$6,454	$6,281	$6,083	$5,854	$5,592	$5,291	$4,944	$4,546	$4,089	$3,563	$2,958	$2,263	$1,465	$547
Operating income before depreciation and income taxes	($4,029)	($2,454)	($2,303)	($2,140)	($1,962)	($1,769)	($1,559)	($1,327)	($1,072)	($787)	($472)	($120)	$275	$719	$1,218	$1,783	$2,423	$3,150	$3,975	$4,916
Depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before income taxes	($7,329)	($5,754)	($5,603)	($5,440)	($5,262)	($5,069)	($4,859)	($4,627)	($4,372)	($4,087)	($3,772)	($3,420)	($3,025)	($2,581)	($2,082)	($1,517)	($877)	($150)	$675	$1,616
INCOME TAXES																				
Income before income taxes	($7,329)	($5,754)	($5,603)	($5,440)	($5,262)	($5,069)	($4,859)	($4,627)	($4,372)	($4,087)	($3,772)	($3,420)	($3,025)	($2,581)	($2,082)	($1,517)	($877)	($150)	$675	$1,616
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before CCA	($4,029)	($2,454)	($2,303)	($2,140)	($1,962)	($1,769)	($1,559)	($1,327)	($1,072)	($787)	($472)	($120)	$275	$719	$1,218	$1,783	$2,423	$3,150	$3,975	$4,916
Less: CCA (Class 1: Turbine, etc.)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$275	$719	$1,218	$1,232	$1,182	$1,135	$1,090	$1,046
Note: UCC Class 1	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$32,725	$32,006	$30,788	$29,557	$28,374	$27,239	$26,150	$25,104
CCA (Class 34: Boiler, etc.)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$552	$1,241	$2,015	$2,885	$3,870
Note: UCC Class 34	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$32,448	$31,207	$29,192	$26,307	$22,437
Taxable income	($4,029)	($2,454)	($2,303)	($2,140)	($1,962)	($1,769)	($1,559)	($1,327)	($1,072)	($787)	($472)	($120)	$0	$0	$0	$0	$0	$0	($0)	($0)
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
NET INCOME	($7,329)	($5,754)	($5,603)	($5,440)	($5,262)	($5,069)	($4,859)	($4,627)	($4,372)	($4,087)	($3,772)	($3,420)	($3,025)	($2,581)	($2,082)	($1,517)	($877)	($150)	$675	$1,616
CASH FLOW FROM OPERATIONS																				
Net income	($7,329)	($5,754)	($5,603)	($5,440)	($5,262)	($5,069)	($4,859)	($4,627)	($4,372)	($4,087)	($3,772)	($3,420)	($3,025)	($2,581)	($2,082)	($1,517)	($877)	($150)	$675	$1,616
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Less: principal repayment	$502	$577	$663	$762	$876	$1,006	$1,157	$1,329	$1,528	$1,756	$2,018	$2,320	$2,666	$3,064	$3,522	$4,048	$4,652	$5,347	$6,146	$7,063
Cash flow	($4,531)	($3,031)	($2,966)	($2,902)	($2,838)	($2,775)	($2,716)	($2,656)	($2,600)	($2,543)	($2,490)	($2,440)	($2,392)	($2,345)	($2,304)	($2,265)	($2,229)	($2,197)	($2,171)	($2,147)
Cumulative cash flow	($4,531)	($7,562)	($10,528)	($13,430)	($16,268)	($19,044)	($21,759)	($24,415)	($27,015)	($29,558)	($32,048)	($34,488)	($36,879)	($39,224)	($41,528)	($43,793)	($46,022)	($48,219)	($50,389)	($52,537)

CAPACITY FACTOR	80%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$14.50
CAPITAL COST	$33,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 M.W. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT $33,000,000 IN GOVERNMENT ASSISTANCE IS RECEIVED (50% OF CAPITAL COST)

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.070 per KWH	$8,631	$11,118	$11,451	$11,795	$12,149	$12,513	$12,889	$13,275	$13,674	$14,084	$14,506	$14,941	$15,390	$15,851	$16,327	$16,817	$17,321	$17,841	$18,376	$18,927
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$9,291	$11,798	$12,152	$12,516	$12,892	$13,278	$13,677	$14,087	$14,510	$14,945	$15,393	$15,855	$16,331	$16,821	$17,325	$17,845	$18,380	$18,932	$19,500	$20,085
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,427	$4,322	$4,495	$4,675	$4,862	$5,056	$5,259	$5,469	$5,688	$5,915	$6,152	$6,398	$6,654	$5,920	$7,197	$7,485	$7,784	$8,095	$8,419	$8,756
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,362	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$6,211	$7,218	$7,507	$7,807	$8,119	$8,444	$8,782	$9,133	$9,498	$9,878	$10,273	$10,684	$11,111	$11,556	$12,018	$12,499	$12,999	$13,519	$14,060	$14,622
Operating income before interest, depreciation, and income taxes	$3,080	$4,589	$4,645	$4,709	$4,773	$4,835	$4,895	$4,954	$5,011	$5,067	$5,120	$5,171	$5,219	$5,265	$5,307	$5,346	$5,381	$5,413	$5,440	$5,463
Interest expense (@ 14% p.a.)	$2,509	$2,482	$2,452	$2,417	$2,377	$2,331	$2,278	$2,217	$2,147	$2,066	$1,974	$1,867	$1,745	$1,605	$1,443	$1,257	$1,044	$799	$517	$193
Operating income before depreciation and income taxes	$571	$2,098	$2,193	$2,292	$2,396	$2,504	$2,617	$2,737	$2,864	$3,001	$3,146	$3,304	$3,474	$3,660	$3,864	$4,089	$4,337	$4,614	$4,923	$5,270
Depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Income before income taxes	($1,079)	$448	$543	$642	$746	$854	$967	$1,087	$1,214	$1,351	$1,496	$1,654	$1,824	$2,010	$2,214	$2,439	$2,687	$2,964	$3,273	$3,620
INCOME TAXES																				
Income before income taxes	($1,079)	$448	$543	$642	$746	$854	$967	$1,087	$1,214	$1,351	$1,495	$1,654	$1,824	$2,010	$2,214	$2,439	$2,687	$2,964	$3,273	$3,620
Add: depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Income before CCA	$571	$2,098	$2,193	$2,292	$2,396	$2,504	$2,617	$2,737	$2,864	$3,001	$3,146	$3,304	$3,474	$3,660	$3,864	$4,089	$4,337	$4,614	$4,923	$5,270
Less: CCA (Class 1: Turbine, etc.)	$330	$647	$621	$596	$572	$549	$527	$506	$486	$467	$448	$430	$413	$396	$380	$365	$351	$337	$323	$7,755
Note: UCC Class 1	$16,170	$15,523	$14,902	$14,306	$13,734	$13,185	$12,657	$12,151	$11,665	$11,198	$10,750	$10,320	$9,908	$9,511	$9,131	$8,766	$8,415	$8,078	$7,755	$0
Less: CCA (Class 34: Boiler, etc.)	$241	$1,451	$1,572	$1,695	$1,823	$1,954	$2,090	$2,231	$2,378	$1,063	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Note: UCC Class 34	$16,259	$14,808	$13,236	$11,539	$9,716	$7,762	$5,672	$3,441	$1,063	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxable income	$0	($0)	($0)	($0)	$0	$0	$0	($0)	$0	$1,471	$2,698	$2,874	$3,061	$3,263	$3,484	$3,724	$3,987	$4,277	$4,600	($2,485)
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$662	$1,214	$1,293	$1,378	$1,469	$1,568	$1,676	$1,794	$1,925	$2,070	$0
Income taxes recovered																				$1,118
NET INCOME	($1,079)	$448	$543	$642	$746	$854	$967	$1,087	$1,214	$689	$282	$361	$447	$541	$646	$763	$893	$1,039	$1,203	$4,738
CASH FLOW FROM OPERATIONS																				
Net income	($1,079)	$448	$543	$642	$746	$854	$967	$1,087	$1,214	$689	$282	$361	$447	$541	$646	$763	$893	$1,039	$1,203	$4,738
Add: depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Less: principal repayment	$177	$204	$234	$269	$309	$355	$408	$469	$539	$620	$712	$819	$941	$1,081	$1,243	$1,429	$1,642	$1,887	$2,169	$2,493
Cash flow	$394	$1,894	$1,959	$2,023	$2,087	$2,149	$2,209	$2,268	$2,325	$1,719	$1,220	$1,192	$1,156	$1,110	$1,053	$984	$901	$802	$684	$3,895
Cumulative cash flow	$394	$2,288	$4,247	$6,270	$8,357	$10,505	$12,715	$14,983	$17,308	$19,027	$20,247	$21,439	$22,594	$23,704	$24,758	$25,742	$26,643	$27,446	$28,130	$32,025
Cash flow for rate of return calcs. ($16,500)	$394	$1,894	$1,959	$2,023	$2,087	$2,149	$2,209	$2,268	$2,325	$1,719	$1,220	$1,192	$1,156	$1,110	$1,053	$984	$901	$802	$684	$3,895
Rate of Return on Investors' Capital 7.7%																				

CAPACITY FACTOR	80%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$14.50
CAPITAL COST	$66,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 M.W. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT NO GOVERNMENT ASSISTANCE IS RECEIVED

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.110 per KWH	$13,563	$17,471	$17,995	$18,535	$19,091	$19,664	$20,254	$20,861	$21,487	$22,132	$22,796	$23,479	$24,184	$24,909	$25,657	$26,426	$27,219	$28,036	$28,877	$29,743
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$14,223	$18,151	$18,695	$19,256	$19,834	$20,429	$21,042	$21,673	$22,323	$22,993	$23,682	$24,393	$25,125	$25,879	$26,655	$27,455	$28,278	$29,126	$30,000	$30,900
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,427	$4,322	$4,495	$4,675	$4,862	$5,056	$5,259	$5,469	$5,688	$5,915	$6,152	$6,398	$6,654	$6,920	$7,197	$7,485	$7,784	$8,095	$8,419	$8,756
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,361	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$6,211	$7,218	$7,507	$7,807	$8,119	$8,444	$8,782	$9,133	$9,498	$9,878	$10,273	$10,684	$11,111	$11,556	$12,018	$12,499	$12,999	$13,519	$14,060	$14,622
Operating income before interest, depreciation, and income taxes	$8,012	$10,933	$11,189	$11,449	$11,715	$11,985	$12,260	$12,549	$12,825	$13,115	$13,409	$13,709	$14,013	$14,323	$14,637	$14,956	$15,279	$15,608	$15,941	$16,278
Interest expense (@ 14% p.a.)	$7,109	$7,034	$6,948	$6,849	$6,735	$6,604	$6,454	$6,281	$6,083	$5,854	$5,592	$5,291	$4,944	$4,546	$4,089	$3,563	$2,958	$2,263	$1,465	$547
Operating income before depreciation and income taxes	$903	$3,899	$4,241	$4,599	$4,980	$5,381	$5,806	$6,259	$6,742	$7,261	$7,817	$8,418	$9,069	$9,777	$10,548	$11,393	$12,321	$13,345	$14,476	$15,731
Depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before income taxes	($2,397)	$599	$941	$1,300	$1,680	$2,081	$2,506	$2,959	$3,442	$3,961	$4,517	$5,118	$5,769	$6,477	$7,248	$8,093	$9,021	$10,045	$11,176	$12,431
INCOME TAXES																				
Income before income taxes	($2,397)	$599	$941	$1,300	$1,680	$2,081	$2,506	$2,959	$3,442	$3,961	$4,517	$5,118	$5,769	$6,477	$7,248	$8,093	$9,021	$10,045	$11,176	$12,431
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before CCA	$903	$3,899	$4,241	$4,599	$4,980	$5,381	$5,806	$6,259	$6,742	$7,261	$7,817	$8,418	$9,069	$9,777	$10,548	$11,393	$12,321	$13,345	$14,476	$15,731
Less: CCA (Class 1: Turbine, etc.)	$660	$1,294	$1,242	$1,192	$1,144	$1,099	$1,055	$1,013	$972	$933	$896	$860	$826	$793	$761	$730	$701	$673	$646	$15,510
Note: UCC Class 1	$32,340	$31,046	$29,805	$28,612	$27,468	$26,369	$25,314	$24,302	$23,330	$22,397	$21,501	$20,641	$19,815	$19,022	$18,262	$17,531	$16,830	$16,157	$15,510	$0
Less: CCA (Class 34: Boiler, etc.)	$243	$2,605	$2,999	$3,402	$3,835	$4,282	$4,751	$5,246	$5,529	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Note: UCC Class 34	$32,757	$30,152	$27,153	$23,745	$19,909	$15,627	$10,876	$5,629	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxable income	$0	($0)	($0)	($0)	$0	$0	$0	($0)	$140	$6,327	$6,921	$7,558	$8,244	$8,984	$9,787	$10,662	$11,620	$12,671	$13,829	$221
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$0	$63	$2,847	$3,115	$3,401	$3,710	$4,043	$4,404	$4,798	$5,229	$5,702	$6,223	$99
NET INCOME	($2,397)	$599	$941	$1,300	$1,680	$2,081	$2,506	$2,959	$3,379	$1,113	$1,403	$1,717	$2,060	$2,434	$2,844	$3,295	$3,792	$4,343	$4,952	$12,332
CASH FLOW FROM OPERATIONS																				
Net income	($2,397)	$599	$941	$1,300	$1,680	$2,081	$2,506	$2,959	$3,379	$1,113	$1,403	$1,717	$2,060	$2,434	$2,844	$3,295	$3,792	$4,343	$4,952	$12,332
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Less: principal repayment	$502	$577	$663	$762	$876	$1,006	$1,157	$1,329	$1,528	$1,755	$2,018	$2,320	$2,665	$3,064	$3,522	$4,048	$4,652	$5,347	$6,145	$7,063
Cash flow	$401	$3,322	$3,578	$3,838	$4,104	$4,375	$4,649	$4,930	$5,151	$2,657	$2,685	$2,697	$2,694	$2,670	$2,622	$2,547	$2,440	$2,296	$2,106	$8,569
Cumulative cash flow	$401	$3,723	$7,301	$11,139	$15,243	$19,618	$24,267	$29,197	$34,347	$37,005	$39,689	$42,386	$45,080	$47,750	$50,371	$52,918	$55,358	$57,654	$59,760	$68,329
Cash Flow for Rate of Return Calcs. ($16,500)	$401	$3,322	$3,578	$3,838	$4,104	$4,375	$4,649	$4,930	$5,151	$2,657	$2,685	$2,697	$2,694	$2,670	$2,622	$2,547	$2,440	$2,296	$2,106	$8,569
Rate of Return on Investors' Capital 18.76%																				

CAPACITY FACTOR	90%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$15.00
CAPITAL COST	$66,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 M.W. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT NO GOVERNMENT ASSISTANCE IS RECEIVED

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.070 per KWH	$9,667	$12,509	$12,885	$13,271	$13,669	$14,079	$14,502	$14,937	$15,385	$15,846	$16,322	$16,812	$17,316	$17,835	$18,370	$18,922	$19,489	$20,074	$20,676	$21,296
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$10,327	$13,189	$13,585	$13,992	$14,412	$14,845	$15,290	$15,749	$16,221	$16,708	$17,209	$17,725	$18,257	$18,805	$19,369	$19,950	$20,548	$21,165	$21,800	$22,454
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,934	$4,982	$5,181	$5,389	$5,604	$5,828	$6,062	$6,304	$6,556	$6,818	$7,091	$7,375	$7,670	$7,977	$8,296	$8,628	$8,973	$9,332	$9,705	$10,093
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,362	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$6,718	$7,878	$8,193	$8,521	$8,861	$9,216	$9,585	$9,968	$10,367	$10,781	$11,213	$11,661	$12,128	$12,613	$13,117	$13,642	$14,188	$14,755	$15,345	$15,959
Operating income before interest, depreciation, and income taxes	$3,609	$5,311	$5,392	$5,472	$5,551	$5,629	$5,705	$5,781	$5,854	$5,926	$5,996	$6,064	$6,129	$6,192	$6,252	$6,308	$6,361	$6,410	$6,454	$6,495
Interest expense (@ 14% p.a.)	$7,109	$7,034	$6,948	$6,849	$6,735	$6,604	$6,454	$6,281	$6,083	$5,854	$5,592	$5,291	$4,944	$4,546	$4,089	$3,563	$2,958	$2,263	$1,465	$547
Operating income before depreciation and income taxes	($3,500)	($1,723)	($1,556)	($1,377)	($1,184)	($975)	($749)	($500)	($229)	$72	$404	$773	$1,185	$1,646	$2,163	$2,745	$3,403	$4,147	$4,989	$5,948
Depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before income taxes	($6,800)	($5,023)	($4,856)	($4,677)	($4,484)	($4,275)	($4,049)	($3,800)	($3,529)	($3,228)	($2,896)	($2,527)	($2,115)	($1,654)	($1,137)	($555)	$103	$847	$1,689	$2,648
INCOME TAXES																				
Income before income taxes	($6,800)	($5,023)	($4,856)	($4,677)	($4,484)	($4,275)	($4,049)	($3,800)	($3,529)	($3,228)	($2,896)	($2,527)	($2,115)	($1,654)	($1,137)	($555)	$103	$847	$1,689	$2,648
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before CCA	($3,500)	($1,723)	($1,556)	($1,377)	($1,184)	($975)	($749)	($500)	($229)	$72	$404	$773	$1,185	$1,646	$2,163	$2,745	$3,403	$4,147	$4,989	$5,948
Less: CCA (Class 1: Turbine, etc.)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$72	$404	$773	$1,185	$1,223	$1,174	$1,127	$1,082	$1,038	$997	$957
Note: UCC Class 1	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$32,928	$32,523	$31,750	$30,565	$29,343	$28,169	$27,042	$25,960	$24,922	$23,925	$22,968
CCA (Class 34: Boiler, etc.)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$423	$989	$1,518	$2,321	$3,108	$3,993	$4,991
Note: UCC Class 34	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$33,000	$32,577	$31,588	$29,970	$27,649	$24,540	$20,548	$15,557
Taxable income	($3,500)	($1,723)	($1,556)	($1,377)	($1,184)	($975)	($749)	($500)	($229)	$0	$0	$0	$0	$0	$0	$0	($0)	($0)	$0	$0
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
NET INCOME	($6,800)	($5,023)	($4,856)	($4,677)	($4,484)	($4,275)	($4,049)	($3,800)	($3,529)	($3,228)	($2,896)	($2,527)	($2,115)	($1,654)	($1,137)	($555)	$103	$847	$1,689	$2,648
CASH FLOW FROM OPERATIONS																				
Net income	($6,800)	($5,023)	($4,856)	($4,677)	($4,484)	($4,275)	($4,049)	($3,800)	($3,529)	($3,228)	($2,896)	($2,527)	($2,115)	($1,654)	($1,137)	($555)	$103	$847	$1,689	$2,648
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Less: principal repayment	$502	$577	$663	$762	$876	$1,006	$1,157	$1,329	$1,528	$1,756	$2,018	$2,320	$2,666	$3,054	$3,522	$4,048	$4,652	$5,347	$6,145	$7,063
Cash flow	($4,002)	($2,300)	($2,219)	($2,139)	($2,060)	($1,981)	($1,906)	($1,829)	($1,757)	($1,684)	($1,614)	($1,547)	($1,481)	($1,418)	($1,359)	($1,303)	($1,249)	($1,200)	($1,157)	($1,115)
Cumulative cash flow	($4,002)	($6,302)	($8,521)	($10,661)	($12,721)	($14,702)	($16,608)	($18,438)	($20,194)	($21,878)	($23,492)	($25,039)	($26,519)	($27,937)	($29,297)	($30,600)	($31,849)	($33,050)	($34,206)	($35,322)

CAPACITY FACTOR	90%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$15.00
CAPITAL COST	$33,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 M.W. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT $33,000,000 IN GOVERNMENT ASSISTANCE IS RECEIVED (50% OF CAPITAL COST)

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.070 per KWH	$9,667	$12,509	$12,885	$13,271	$13,669	$14,079	$14,502	$14,937	$15,385	$15,846	$16,322	$16,812	$17,316	$17,835	$18,370	$18,922	$19,489	$20,074	$20,676	$21,296
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$10,327	$13,189	$13,585	$13,992	$14,412	$14,845	$15,290	$15,749	$16,221	$16,708	$17,209	$17,725	$18,257	$18,805	$19,369	$19,950	$20,548	$21,165	$21,800	$22,454
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,934	$4,982	$5,181	$5,389	$5,604	$5,828	$6,062	$6,304	$6,556	$6,818	$7,091	$7,375	$7,670	$7,977	$8,296	$8,628	$8,973	$9,332	$9,705	$10,093
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,362	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$6,718	$7,878	$8,193	$8,521	$8,861	$9,216	$9,585	$9,968	$10,367	$10,781	$11,213	$11,661	$12,128	$12,613	$13,117	$13,642	$14,188	$14,755	$15,345	$15,959
Operating income before interest, depreciation, and income taxes	$3,509	$5,311	$5,392	$5,472	$5,551	$5,629	$5,705	$5,781	$5,854	$5,926	$5,996	$6,064	$6,129	$6,192	$6,252	$6,308	$6,361	$6,410	$6,454	$6,495
Interest expense (@ 14% p.a.)	$2,509	$2,482	$2,452	$2,417	$2,377	$2,331	$2,278	$2,217	$2,147	$2,066	$1,974	$1,867	$1,745	$1,605	$1,443	$1,257	$1,044	$799	$517	$193
Operating income before depreciation and income taxes	$1,100	$2,829	$2,940	$3,055	$3,174	$3,298	$3,427	$3,564	$3,707	$3,860	$4,022	$4,197	$4,384	$4,587	$4,809	$5,051	$5,317	$5,611	$5,937	$6,302
Depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Income before income taxes	($550)	$1,179	$1,290	$1,405	$1,524	$1,648	$1,777	$1,914	$2,057	$2,210	$2,372	$2,547	$2,734	$2,937	$3,159	$3,401	$3,667	$3,961	$4,287	$4,652
INCOME TAXES																				
Income before income taxes	($550)	$1,179	$1,290	$1,405	$1,524	$1,648	$1,777	$1,914	$2,057	$2,210	$2,372	$2,547	$2,734	$2,937	$3,159	$3,401	$3,667	$3,961	$4,287	$4,652
Add: depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Income before CCA	$1,100	$2,829	$2,940	$3,055	$3,174	$3,298	$3,427	$3,564	$3,707	$3,860	$4,022	$4,197	$4,384	$4,587	$4,809	$5,051	$5,317	$5,611	$5,937	$6,302
Less: CCA (Class 1: Turbine, etc.)	$330	$647	$621	$595	$572	$549	$527	$506	$486	$467	$448	$430	$413	$396	$380	$365	$351	$337	$323	$7,755
Note: UCC Class 1	$16,170	$15,523	$14,902	$14,305	$13,734	$13,185	$12,657	$12,151	$11,665	$11,198	$10,750	$10,320	$9,908	$9,511	$9,131	$8,766	$8,415	$8,078	$7,755	$0
Less: CCA (Class 34: Boiler, etc.)	$770	$2,183	$2,319	$2,459	$2,601	$2,748	$2,900	$521	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Note: UCC Class 34	$15,730	$13,548	$11,229	$8,770	$6,169	$3,421	$521	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxable income	$0	$0	($0)	$0	($0)	$0	$0	$2,536	$3,221	$3,394	$3,574	$3,767	$3,972	$4,191	$4,428	$4,686	$4,966	$5,274	$5,614	($1,454)
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$1,141	$1,450	$1,527	$1,608	$1,695	$1,787	$1,886	$1,993	$2,109	$2,235	$2,373	$2,526	$0
Income taxes recovered																				$654
NET INCOME	($550)	$1,179	$1,290	$1,405	$1,524	$1,648	$1,777	$772	$608	$683	$764	$852	$947	$1,051	$1,166	$1,292	$1,432	$1,587	$1,761	$5,306
CASH FLOW FROM OPERATIONS																				
Net income	($550)	$1,179	$1,290	$1,405	$1,524	$1,648	$1,777	$772	$608	$683	$764	$852	$947	$1,051	$1,166	$1,292	$1,432	$1,587	$1,761	$5,306
Add: depreciation	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
Less: principal repayment	$177	$204	$234	$269	$309	$355	$408	$469	$539	$620	$712	$819	$941	$1,081	$1,243	$1,429	$1,642	$1,887	$2,169	$2,493
Cash flow	$923	$2,625	$2,706	$2,786	$2,865	$2,943	$3,019	$1,953	$1,719	$1,713	$1,702	$1,683	$1,656	$1,620	$1,573	$1,513	$1,440	$1,350	$1,242	$4,463
Cumulative cash flow	$923	$3,548	$6,254	$9,039	$11,904	$14,847	$17,866	$19,819	$21,538	$23,251	$24,953	$25,636	$28,292	$29,912	$31,485	$32,998	$34,438	$35,788	$37,030	$41,493
Cash flow for rate of return calcs. ($16,500)	$923	$2,625	$2,706	$2,786	$2,865	$2,943	$3,019	$1,953	$1,719	$1,713	$1,702	$1,683	$1,656	$1,620	$1,573	$1,513	$1,440	$1,350	$1,242	$4,463
Rate of Return on Investors' Capital 11.7%																				

CAPACITY FACTOR	90%
ECONOMIC LIFE	20 YEARS
SALVAGE VALUE	0
AVERAGE FUEL COST	$15.00
CAPITAL COST	$66,000
WORKING CAPITAL	$1,500

PROFORMA ECONOMIC ANALYSIS - 25 M.W. WOOD FUELED POWER PLANT (ALL FIGURES X 1000) ASSUMES THAT NO GOVERNMENT ASSISTANCE IS RECEIVED

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
REVENUES																				
Electricity sales @ $0.105 per KWH	$14,501	$18,764	$19,327	$19,907	$20,504	$21,119	$21,753	$22,405	$23,077	$23,770	$24,483	$25,217	$25,974	$26,753	$27,556	$28,382	$29,234	$30,111	$31,014	$31,944
Steam Sales (40,000 lbs/hr)	$660	$680	$700	$721	$743	$765	$788	$812	$836	$861	$887	$914	$941	$969	$998	$1,028	$1,059	$1,091	$1,124	$1,157
Total Revenues	$15,161	$19,444	$20,027	$20,628	$21,247	$21,884	$22,541	$23,217	$23,913	$24,631	$25,370	$26,131	$26,915	$27,722	$28,554	$29,411	$30,293	$31,202	$32,138	$33,102
OPERATING COSTS																				
Fuel costs (wood @ 50% M.C.)	$3,934	$4,982	$5,181	$5,389	$5,604	$5,828	$6,062	$6,304	$6,556	$6,818	$7,091	$7,375	$7,670	$7,977	$8,296	$8,628	$8,973	$9,332	$9,705	$10,093
Labour	$1,345	$1,399	$1,455	$1,513	$1,574	$1,637	$1,702	$1,770	$1,841	$1,915	$1,991	$2,071	$2,154	$2,240	$2,330	$2,423	$2,520	$2,621	$2,725	$2,834
Maintenance and service	$1,164	$1,211	$1,259	$1,309	$1,362	$1,416	$1,473	$1,532	$1,593	$1,657	$1,723	$1,792	$1,864	$1,938	$2,016	$2,096	$2,180	$2,267	$2,358	$2,452
Insurances	$88	$91	$95	$99	$103	$107	$111	$115	$120	$125	$130	$135	$140	$146	$152	$158	$164	$171	$178	$185
Property taxes	$187	$195	$202	$211	$219	$228	$237	$246	$256	$266	$277	$288	$300	$312	$324	$337	$351	$365	$379	$394
Total Costs	$5,718	$7,878	$8,193	$8,521	$8,861	$9,216	$9,585	$9,968	$10,367	$10,781	$11,213	$11,661	$12,128	$12,613	$13,117	$13,642	$14,188	$14,755	$15,345	$15,959
Operating income before interest, depreciation, and income taxes	$8,442	$11,566	$11,834	$12,107	$12,385	$12,668	$12,956	$13,249	$13,547	$13,850	$14,157	$14,470	$14,787	$15,110	$15,437	$15,769	$16,105	$16,447	$16,792	$17,143
Interest expense (@ 14% p.a.)	$7,109	$7,034	$6,948	$6,849	$6,735	$6,604	$6,454	$6,281	$6,083	$5,854	$5,592	$5,291	$4,944	$4,546	$4,089	$3,563	$2,958	$2,263	$1,465	$547
Operating income before depreciation and income taxes	$1,333	$4,532	$4,886	$5,258	$5,650	$6,064	$6,502	$6,968	$7,464	$7,996	$8,565	$9,179	$9,843	$10,564	$11,348	$12,206	$13,147	$14,184	$15,327	$16,596
Depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before income taxes	($1,967)	$1,232	$1,586	$1,958	$2,350	$2,764	$3,202	$3,668	$4,164	$4,696	$5,265	$5,879	$6,543	$7,264	$8,048	$8,906	$9,847	$10,884	$12,027	$13,296
INCOME TAXES																				
Income before income taxes	($1,967)	$1,232	$1,586	$1,958	$2,350	$2,764	$3,202	$3,668	$4,164	$4,696	$5,265	$5,879	$6,543	$7,264	$8,048	$8,906	$9,847	$10,884	$12,027	$13,296
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Income before CCA	$1,333	$4,532	$4,886	$5,258	$5,650	$6,064	$6,502	$6,968	$7,464	$7,996	$8,565	$9,179	$9,843	$10,564	$11,348	$12,206	$13,147	$14,184	$15,327	$16,596
Less: CCA (Class 1: Turbine, etc.)	$660	$1,294	$1,242	$1,192	$1,144	$1,099	$1,055	$1,013	$972	$933	$896	$860	$826	$793	$761	$730	$701	$673	$646	$15,510
Note: UCC Class 1	$32,340	$31,046	$29,805	$28,612	$27,468	$26,359	$25,314	$24,302	$23,330	$22,397	$21,501	$20,641	$19,815	$19,022	$18,262	$17,531	$16,830	$16,157	$15,510	$0
CCA (Class 34: Boiler, etc.)	$673	$3,238	$3,644	$4,066	$4,505	$4,966	$5,447	$5,955	$504	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Note: UCC Class 34	$32,327	$29,089	$25,444	$21,378	$16,872	$11,907	$6,459	$504	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Taxable income	$0	($0)	($0)	($0)	($0)	$0	$0	($0)	$5,988	$7,062	$7,669	$8,319	$9,018	$9,771	$10,587	$11,475	$12,446	$13,510	$14,681	$1,085
Income taxes payable (45%)	$0	$0	$0	$0	$0	$0	$0	$0	$2,694	$3,178	$3,451	$3,743	$4,058	$4,397	$4,764	$5,164	$5,601	$6,080	$6,607	$488
NET INCOME	($1,967)	$1,232	$1,586	$1,958	$2,350	$2,764	$3,202	$3,668	$1,469	$1,517	$1,814	$2,135	$2,485	$2,867	$3,284	$3,742	$4,247	$4,804	$5,421	$12,807
CASH FLOW FROM OPERATIONS																				
Net income	($1,967)	$1,232	$1,586	$1,958	$2,350	$2,764	$3,202	$3,668	$1,469	$1,517	$1,814	$2,135	$2,485	$2,867	$3,284	$3,742	$4,247	$4,804	$5,421	$12,807
Add: depreciation	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300	$3,300
Less: principal repayment	$502	$577	$663	$762	$876	$1,006	$1,157	$1,329	$1,528	$1,756	$2,018	$2,320	$2,666	$3,064	$3,522	$4,048	$4,652	$5,347	$6,146	$7,063
Cash flow	$831	$3,955	$4,223	$4,496	$4,774	$5,058	$5,345	$5,639	$3,241	$3,061	$3,096	$3,115	$3,119	$3,103	$3,062	$2,994	$2,895	$2,757	$2,575	$9,044
Cumulative cash flow	$831	$4,786	$9,009	$13,505	$18,280	$23,338	$28,683	$34,322	$37,563	$40,625	$43,721	$46,836	$49,956	$53,058	$56,120	$59,114	$62,008	$64,765	$67,340	$76,385
Cash Flow for Rate of Return Calcs. ($16,500)	$831	$3,955	$4,223	$4,496	$4,774	$5,058	$5,345	$5,639	$3,241	$3,061	$3,096	$3,115	$3,119	$3,103	$3,062	$2,994	$2,895	$2,757	$2,575	$9,044
Rate of Return on Investors' Capital 21.58%																				

25 MW PLANT

SUMMARY OF PRO FORMA STATEMENTS

Economic life = 20 years, Salvage value = $0, Costs for 1990 escalated to Year 1, Revenues for Year 1

CASE	CAPACITY FACTOR	AVERAGE FUEL COST	CAPITAL COST	WORKING CAPITAL	INTEREST RATE	POWER COST	CASE FLOW	RATE OF RETURN ON INVESTED CAPITAL
			$ millions	$ millions				
BASE CASE	80%	$14.50	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
50% GRANT CASE	80%	$14.50	$33	$1.5	14%	7.0 ¢/kwh	Positive Throughout	7.7%
DEVELOPED POWER COST ON BASE CASE	80%	$14.50	$66	$1.5	14%	11.0 ¢/kwh	Positive Throughout	18.8%
BASE CASE WITH CAPITAL COST +10%	80%	$14.50	$72.6	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH CAPITAL COST -10%	80%	$14.50	$59.4	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH FUEL COST +10%	80%	$15.95	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH FUEL COST -10%	80%	$13.05	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH INTEREST RATE +2%	80%	$14.50	$66	$1.5	16%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH INTEREST RATE -2%	80%	$14.50	$66	$1.5	12%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH POWER COSTS DEVELOPED, CAPITAL COST +10%	80%	$14.50	$72.6	$1.5	14%	12.0 ¢/kwh	Positive Throughout	21.0%
BASE CASE WITH POWER COSTS DEVELOPED, CAPITAL COST -10%	80%	$14.50	$59.4	$1.5	14%	10.5 ¢/kwh	Positive Throughout	20.0%
BASE CASE WITH POWER COSTS DEVELOPED, FUEL COST +10%	80%	$15.95	$66	$1.5	14%	11.5 ¢/kwh	Positive Throughout	20.5%
BASE CASE WITH POWER COSTS DEVELOPED, FUEL COST -10%	80%	$13.05	$66	$1.5	14%	11.0 ¢/kwh	Positive Throughout	20.4%
BASE CASE WITH POWER COSTS DEVELOPED, INTEREST RATE +2%	80%	$14.50	$66	$1.5	16%	11.7 ¢/kwh	Positive Throughout	20.1%
BASE CASE WITH POWER COSTS DEVELOPED, INTEREST RATE -2%	80%	$14.50	$66	$1.5	12%	10.7 ¢/kwh	Positive Throughout	20.2%
BASE CASE	90%	$15.00	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
50% GRANT CASE	90%	$15.00	$33	$1.5	14%	7.0 ¢/kwh	Positive Throughout	11.7%
DEVELOPED POWER COST ON BASE CASE	90%	$15.00	$66	$1.5	14%	10.5 ¢/kwh	Positive Throughout	21.6%
BASE CASE WITH CAPITAL COST +10%	90%	$15.00	$72.6	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH CAPITAL COST -10%	90%	$15.00	$59.4	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH FUEL COST +10%	90%	$16.50	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH FUEL COST -10%	90%	$13.50	$66	$1.5	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH INTEREST RATE +2%	90%	$15.00	$66	$1.5	16%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH INTEREST RATE -2%	90%	$15.00	$66	$1.5	12%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH POWER COSTS DEVELOPED, CAPITAL COST +10%	90%	$15.00	$72.6	$1.5	14%	11.0 ¢/kwh	Positive Throughout	20.7%
BASE CASE WITH POWER COSTS DEVELOPED, CAPITAL COST -10%	90%	$15.00	$59.4	$1.5	14%	9.8 ¢/kwh	Positive Throughout	20.8%
BASE CASE WITH POWER COSTS DEVELOPED, FUEL COST +10%	90%	$16.50	$66	$1.5	14%	10.5 ¢/kwh	Positive Throughout	19.1%
BASE CASE WITH POWER COSTS DEVELOPED, FUEL COST -10%	90%	$13.50	$66	$1.5	14%	10.0 ¢/kwh	Positive Throughout	19.8%
BASE CASE WITH POWER COSTS DEVELOPED, INTEREST RATE +2%	90%	$15.00	$66	$1.5	16%	10.8 ¢/kwh	Positive Throughout	20.2%
BASE CASE WITH POWER COSTS DEVELOPED, INTEREST RATE -2%	90%	$15.00	$66	$1.5	12%	9.9 ¢/kwh	Positive Throughout	20.3%

APPENDIX IV

Preliminary Data

for

50 MW Plant

DATA SUMMARY FOR A 50 MW WOOD-FIRED ELECTRIC POWER GENERATION PLANT @ KEDGWICK, N.B.

The terms of reference for the study, state that the plant capacity will be based on wood fuel availability consistent with reasonable cost. As noted earlier in the report there is an adequate supply of wood residue which may be processed into a suitable fuel for a power station having a capacity of 50 MW. Further as noted earlier, a plant capacity of 25 MW is favoured. The reasons are:

- the volume of heavy truck/van traffic is high at an estimated 40 loads per 8 hours day.
- the higher cost for the incremental increase in fuel quantities as transport becomes a bigger cost component.
- a 50 MW unit would be a more sophisticated plant with greater demands on staff capabilities.

As a result of the foregoing, the main thrust of our report is directed to a 25 MW unit.

It was felt, however, that some data should be provided to acquaint the committee with order of magnitude details for a 50 MW unit based on 80% and 90% capacity factors.

The following summarizes the preliminary data as developed; (Costs assume 1990 dollars).

(i) Capital & Operating Costs

Capital Costs		-$115,500,000
Wood Fuel Consumption	-	463.700 Tonnes (@ 50% MC) for the 80% Capacity Factor
(assumes same amount of steam supplied to sawmills)	-	518,000 Tonnes (@ 50% MC) for the 90% Capacity Factor
Wood Fuel Cost:		
@ 80% capacity factor	-	$ 8,161,100
@ 90% capacity factor	-	$ 9,324,000
Insurance	-	$ 135,000
Taxes (Property)	-	$ 288,000
Staff 39 Persons	-	$ 1,470,000
Maintenance & Servicing	-	$ 1,809,000

(ii) Electrical energy output in year 2 = 346.9×10^6 for 90% Capacity Factor and 308.3×10^6 got 90%

(iii) Steam energy output 0.22×10^{12} Btu

(iv) Proforma analyses have been prepared based on the following:

90% Capacity Factors	(L.F.)
Economic Life	20 Years
Avg. Fuel Cost $1990	= $18.00 for 90% & $17.60 for 80%
Capital Cost	= $115,500,000
Working Capital	= $1,500,000

Copies of two (2) performance scenarios, (1) without grant and with developed (actual) costs per kWh output.

The result of the financial analyses are shown in the attached table.

(v) Power Sales - to NB Power @ 7¢/kWh for Year 1

Power Generated in kWh's

Capacity Factor	Year 1	Year 2 to 20
80%	246.6×10^6	308.3×10^6
90%	277.5×10^6	346.7×10^6

(vi) Wood Fuel Consumption

Capacity Factor	Year 1	Year 2 to 20
80%	377,000	463,700
90%	420,000	518,000

(vii) Maintenance & Servicing

No change from our expected maintenance and servicing account - since the full amount will be used to meet unusual problems during the commissioning and immediately following the commissioning.

50 MW PLANT

SUMMARY OF PRO FORMA STATEMENTS

Economic life = 20 years, Salvage value = $0, Costs for 1990 escalated to Year 1, Revenues for Year 1

CASE	CAPACITY FACTOR	AVERAGE FUEL COST	CAPITAL COST	WORKING CAPITAL	INTEREST RATE	POWER COST	CASH FLOW	RATE OF RETURN ON INVESTED CAPITAL
			$ millions	$ millions				
BASE CASE	80%	$17.60	$115.5	$3.0	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH DEVELOPED POWER COST	80%	$17.60	$115.5	$3.0	14%	10.7 ¢/kwh	Positive Throughout	21.4%
BASE CASE	90%	$18.00	$115.5	$3.0	14%	7.0 ¢/kwh	Negative Throughout	N/A
BASE CASE WITH DEVELOPED POWER COST	90%	$18.00	$115.5	$3.0	14%	10.0 ¢/kwh	Positive Throughout	19.8%